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A review of the water mite family Pionidae in Australia (Acarina: Hygrobatoidea)

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Abstract – The Australian Pionidae consists of 11 species in six genera: *Larri* gen. nov. (with type species *L. laffa* sp. nov.), *Australotiphys* Cook (with *A. magnisetus* Cook, *A. himonius* sp. nov. and *A. barmutai* sp. nov.), *Acercella* Lundblad (with *A. falcipes* Lundblad and *A. poorginup* sp. nov.), *Piona* Koch (with *P. cumberlandensis* (Rainbow), *P. australica* K.O. Viets, *P. puripalpis* K.O. Viets, *P. murleyi* sp. nov. and *P. marchanti* sp. nov.). Mating in *Acercella falcipes* Lundblad and *Piona cumberlandensis* (Rainbow) is briefly discussed.

INTRODUCTION

Water mites of the family Pionidae are widespread throughout the Holarctic region where many genera are currently recognised (Cook 1974; Smith 1976; Simmons and Smith 1984). The fauna of the southern hemisphere is less well known and only diverse genera such as *Piona* Koch have been recorded frequently. Nevertheless, a distinct and very interesting Australian pionid fauna is present.

The first described Australian species, *Atax cumberlandensis* Rainbow, was not recognised as a member of the genus *Piona* until 1986 (Cook 1986). *Piona uncatiformis* and *Acercella falcipes* were described by Lundblad (1941), and two further species of *Piona* were added by K.O. Viets (1980, 1984). The enigmatic *Australotiphys magnisetus* Cook was described by Cook (1986). With the recent discovery of additional species of these three genera, as well as an undescribed genus from southwestern Australia, it became apparent that a review of the Pionidae of Australia would be profitable. The results of that study are presented here.

MATERIALS AND METHODS

Specimens are lodged in the following repositories:

ANIC	Australian National Insect Collection, Canberra
AM	Australian Museum, Sydney
CNC	Canadian National Collection, Ottawa
DCC	D. R. Cook collection, Detroit
NMV	Museum of Victoria, Melbourne
QVM	Queen Victoria Museum, Launceston
SAM	South Australian Museum, Adelaide
SMNH	Swedish Museum of Natural History, Stockholm
TM	Tasmanian Museum and Art Gallery, Hobart
VC	Viets private collection, Wilhelmshaven
WAM	Western Australian Museum, Perth

Methods follow Harvey (1987). Where the measurements are expressed as a fraction, the numerator refers to the length of the structure and the denominator refers to its width. Abbreviations for glandularia follow Harvey (1987): dg1–5 refers to the dorsoglandularia series, lg1–4 refers to the lateroglandularia series, and vg1–5 and vgx refers to the ventroglandularia series. Unless otherwise stated, the body colour is of specimens fixed and stored in Koenike's solution (Cook 1974), and refers to the sclerotized portions of the body (e.g., legs, coxae), rather than the soft portions. Those specimens denoted as 'SL' are mounted on slides, while those denoted as 'FL' are retained in fluid.

The terminology of water mite pedipalp and leg segments has been inconsistently applied by various workers. I here propose to alter the system that I have previously employed to name the leg segments, and replace them with names used in other arachnid groups (e.g. Shultz 1989, 1990; Harvey 1992), thus providing consistency within the class. Nearly all arachnids have six segments in the pedipalp (coxa, trochanter, femur, patella, tibia and tarsus), and seven segments in the legs (coxa, trochanter, femur, patella, tibia, metatarsus and tarsus) which clearly points to the homologous nature of leg segmentation within the Arachnida.

SYSTEMATICS

Family Pionidae Thor

Remarks

Recent diagnoses and classifications of the Pionidae (Cook 1974; Smith 1976) have emphasised the lack of definite apomorphies, even when the critically important larvae are taken into consideration. One of the most perplexing taxa is *Wettina* Piersig which was considered to be the sister-group of the remaining pionids by Smith (1976). I believe a case could be made for the removal of *Wettina* from the Pionidae and placing it closer to the aturid subfamily Frontipodopsinae (Harvey 1990). Even with *Wettina* removed, the remaining group of genera lacks autapomorphies and the task of delimiting the Pionidae remains a severe difficultly (Cook 1974, in particular the key on p. 26).

Key to Australian species of Pionidae

Males

1. No segments of leg IV modified (Figures 8, 20, 30); tarsal claws of leg III of similar size and shape 2
   At least one segment of leg IV modified (e.g. Figures 40, 62–64); tarsal claws of leg III of different sizes and shape (e.g. Figures 39, 61) 5
2. Three pairs of acetabula (Figure 5) ..... *Larri laffa* sp. nov.
   More than three pairs of acetabula (Figures 12, 15, 25) ..... *Australotiphys* 3
3. Setae of tibia and metatarsus IV thickened (Figure 20); ventral shield present (Figures 12, 14) 4
   Setae of tibia and metatarsus IV not thickened (Figure 30); ventral shield absent, although with 2 pairs of lateralia (Figure 24) ..... *Australotiphys barmutai* sp. nov.
4. Glandularia lg1 and vg3 situated on ventral shield (Figure 14) ..... *Australotiphys himonius* sp. nov.
   Glandularia lg1 and vg3 situated on dorsum (Figure 11) .... *Australotiphys magnisetus* Cook
5. Metatarsus IV with dorsal blade-like expansion (Figures 40, 50); tibia of leg IV without dorsal concavity containing several stout peg-like setae (Figures 40, 50) ..... *Acercella* 6
   Metatarsus IV not modified (e.g. Figure 62); tibia of leg IV with dorsal concavity containing several stout peg-like setae (e.g. Figures 62–64) ..... *Piona* 7
6. Dorsal blade like-expansion of metatarsus IV very thick (Figure 40) ..... *Acercella falcipes* Lundblad
   Dorsal blade-like expansion of metatarsus IV very thin (Figure 50) ..... *Acercella poorginup* sp. nov.
7. Genital field with deep central pit ..... *Piona cumberlandensis* (Rainbow)
   Genital field without central pit (Figures 56, 68, 80) 8
8. Pedipalpal tibia slender, lacking distinct ventral setiferous tubercles (Figure 99) ..... *Piona puripalpis* K.O. Viets
   Pedipalpal tibia moderately stout, with distinct ventral setiferous tubercles (Figures 65, 76, 88) 9
9. Pedipalpal tibia with distal thickened seta (Figures 65, 76); all acetabula incoporated into acetabular plate (Figures 56, 68) 10
   Pedipalpal tibia with sub-distal thickened seta (Figure 88); only some acetabula incorporated into acetabular plate (Figure 80) ..... *Piona murleyi* sp. nov.
10. Anterior claw of leg III without ventral clawlet (Figure 61) ..... *Piona australica* K.O. Viets
    Anterior claw of leg III with ventral clawlet (Figure 72) ..... *Piona marchanti* sp. nov.

Females[1]

1. Three pairs of acetabula (Figures 6, 37, 47) 2
   More than three pairs of acetabula (Figures 18, 28, 57, 70, 82, 94) 4
2. Excretory pore surrounded by sclerotized ring (Figures 35, 45) ..... *Acercella* 3
   Excretory pore not surrounded by sclerotized ring (Figure 3) ..... *Larri laffa* sp. nov.
3. Pedipalpal tibia with 2 large ventral setiferous tubercles ..... *Acercella poorginup* sp. nov.
   Pedipalpal tibia with 2 small ventral setiferous tubercles ..... *Acercella falcipes* Lundblad
4. Coxae fused in mid-line (Figures 17, 27); dorsalia and glandularia platelets large (Figures 16, 26) ..... *Australotiphys* 5
   Coxae not fused in mid-line (Figures 59, 69, 81, 93); dorsalia and glandularia platelets small (Figures 58, 92) ..... *Piona* 6
5. Ventral shield present (Figure 14) ..... *Australotiphys himonius* sp. nov.
   Ventral shield absent, although with 2 pairs of lateralia (Figure 27) ..... *Australotiphys barmutai* sp. nov.
6. Pedipalpal tibia slender, lacking distinct ventral setiferous tubercles (Figure 100) ..... *Piona puripalpis* K.O. Viets

[1] Those of *Australotiphys magnisetus* Cook not known

Pedipalpal tibia moderately stout, with distinct ventral setiferous tubercles (Figures 66, 77, 89) 7

7. Acetabula arranged in 2 distinct, circular groups .... *Piona cumberlandensis* (Rainbow)

Acetabula arranged in 2 semi-circular rows (Figures 57, 70, 82) 8

8. Dorsal setae of pedipalpal femur and patella simple (Figures 66, 77)... *Piona australica* K.O. Viets, *Piona marchanti* sp. nov.

Dorsal setae of pedipalpal femur and patella setose (Figure 89)......... *Piona murleyi* sp. nov.

Subfamily Huitfeldtiinae K. Viets

Larri gen. nov.

Type species

Larri laffa sp. nov.

Diagnosis

Legs III and IV of male unmodified. Body without accessory sclerotization. Genital field with 3 pairs of acetabula. Excretory pore not surrounded by sclerotized ring.

Description

Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia. Venter: coxae not fused into single plate; excretory pore not surrounded by sclerotized ring. Genital region: 3 pairs of circular acetabula; ♂ acetabular plate with medial seta in addition to normal setae, and flanked by several setae. Pedipalpal tibia with 2 ventral setae situated in small tubercles. Legs: unmodified; swimming setae present on all legs.

Remarks

This genus is one of the most plesiomorphic pionid genera, and appears to most closely resemble the Holarctic genus *Huitfeldtia* Thor, from which it differs by the presence of only three pairs of acetabula.

Etymology

The generic epithet is an arbitary combination of letters, and is feminine in gender.

Larri laffa sp. nov.
Figures 1–10

Material Examined

Holotype

♂, Poorginup Swamp, Western Australia, Australia, 34°33'S, 116°44'E, 4 September 1985, M.S. Harvey, T.J. Doeg (WAM 88/2929; SL).

Paratypes

Australia: Western Australia: 2♂, 3♀, 1 deutonymph, same data as holotype (WAM 88/2930–2933, 2939–2940; SL, FL); 2♂, 2♀, same data as holotype (NMV K857–858, K995–996; SL, FL); 1♂, 1♀, same data as holotype (CNC; SL); 1♂, 1♀, same data as holotype (DCC; SL); 2♂, 3♀, Lake William, West Cape Howe Natl Park, 35°05'S, 117°36'E, 3 September 1987, M.S. Harvey, J.D. Blyth (WAM 88/2934–2938; SL); 2♂, 3♀, same data (NMV K861–863, K997–998; SL, FL); 2♂, roadside pool, Chesapeake Road near crossing of Gardiner River, 34°48'S, 116°10'E, 29 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/2941–2942; FL).

Diagnosis

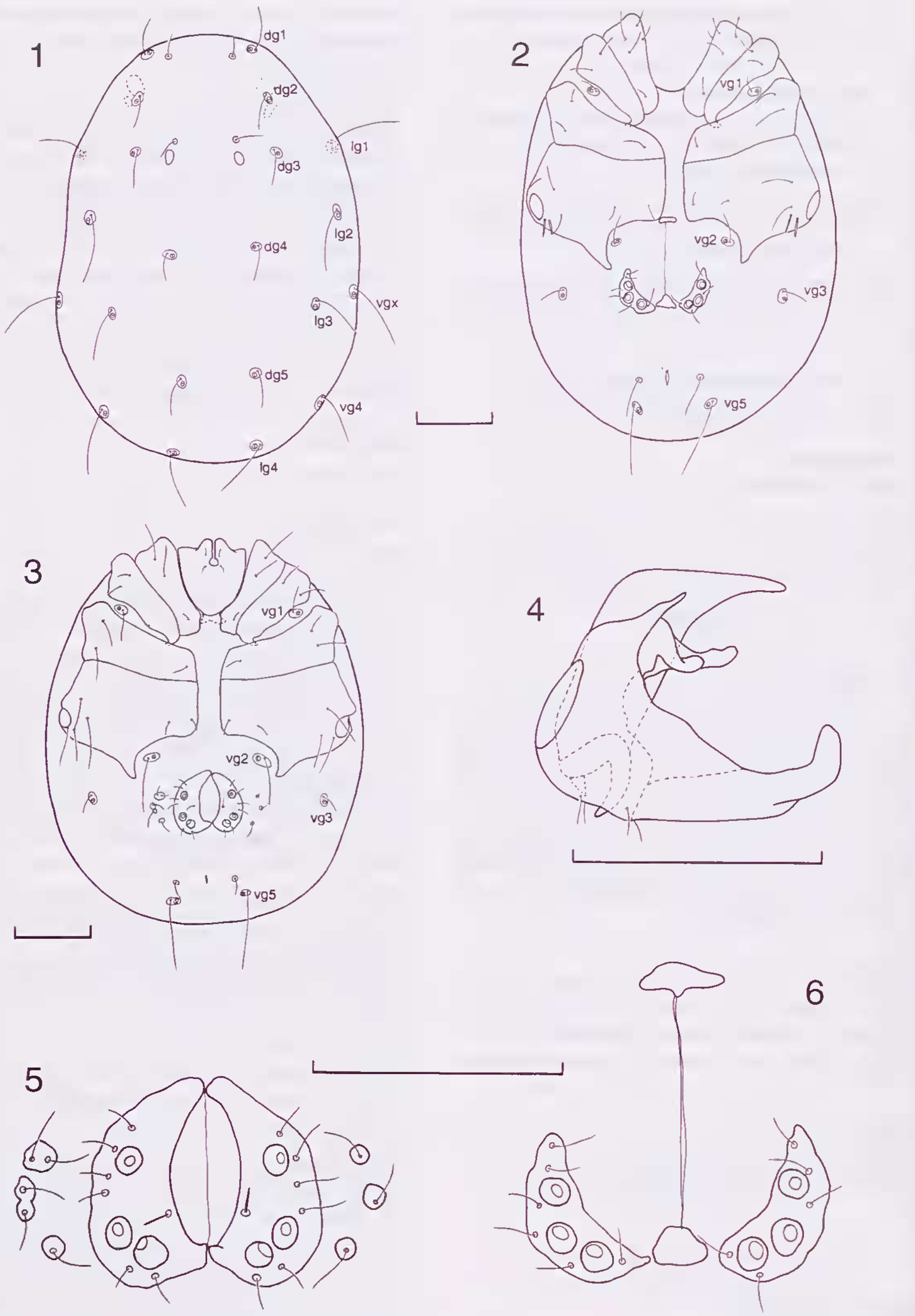
As for genus.

Description

Adult

Colour pale purple. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia (Figures 1–3). Dorsum (Figure 1): with 1 pair of dorsalia slightly posterior to postocularia. Venter (Figures 2–3): coxae not fused into single plate; apodemes of coxa I short; coxae I not fused in mid-line; suture lines between coxae III and IV reaching mid-line, extending laterally; excretory pore not surrounded by sclerotized ring. Genital region (Figures 5–6): 3 pairs of circular acetabula; 5–6 (♂), 5–8 (♀) pairs of small setae present on lateral margin of acetabular plates, a further medial seta present in ♂; acetabular plate of ♂ flanked by several setae. Chelicera stout (Figure 4). Pedipalp (Figure 9): tibia with 2 ventral setae situated in small tubercles, and a single distal, medial seta. Legs (Figures 7–8): unmodified; with swimming setae arranged as follows: leg I: ♂, tibia 0–2, ♀, tibia 1–3, metatarsus 0–2; leg II: ♂, patella 1, tibia 4, metatarsus 4–5, ♀, patella 1, tibia 5–6, metatarsus 3–5; leg III: ♂, patella 1, tibia 4–5, metatarsus 5–6, ♀, patella 1, tibia 6, metatarsus 6–7; leg IV: ♂, patella 1, tibia 4–5, metatarsus 5–7, ♀, patella 1, tibia 4–5, metatarsus 5–7; male legs III and IV not modified.

Dimensions (µm), ♂ (♀): body 531–570/384–429 (506–864/408–518); capitulum length 100–107 (96–121); chelicera length 129 (121); genital field 67–89/84–93 (111–182/108–160). Pedipalp: trochanter 25–29 (25–30), femur 80–84 (86–95), patella 45–52 (48–57), tibia 84–91 (85–99), tarsus 50–51 (49–60). Leg I: trochanter 54–57 (57–65), femur 58–69 (66–80), patella 87–95 (91–102), tibia 115–129 (127–148), metatarsus 135–148 (147–166), tarsus 158–180 (141–186). Leg IV: trochanter 87–99 (94–102), femur 78–



Figures 1–6 *Larri laffa* sp. nov.: 1, dorsal aspect, paratype ♀; 2, ventral aspect, paratype ♀; 3, ventral aspect, holotype ♂; 4, capitulum, lateral aspect, paratype ♀; 5, genital field, holotype ♂; 6, genital field, paratype ♀. Scale lines = 100 μm.

86 (83–102), patella 108–113 (115–140), tibia 137–151 (148–179), metatarsus 157–180 (164–200), tarsus 141–173 (142–192).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Dimensions (μm): body 464/365.

Remarks

This lotic species has been collected from only three localities in southwestern Australia (Figure 10).

Etymology

The specific epithet is an arbitary combination of letters.

Australotiphys Cook

Australotiphys Cook, 1986: 202.

Type species

Australotiphys magnisetus Cook, 1986, by original designation.

Diagnosis

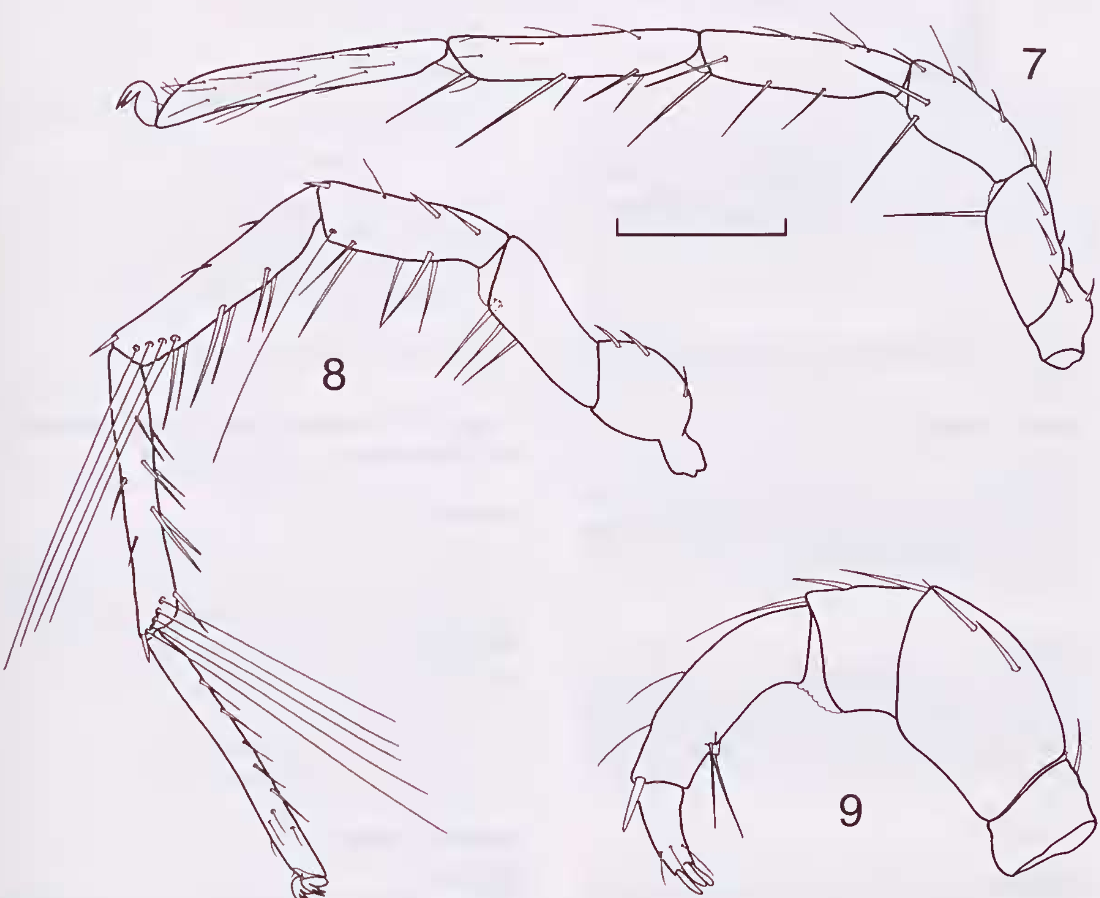
Legs III and IV of male unmodified, except for the presence of enlarged setae on leg IV in two species. Body with accessory sclerotization. Genital field with many pairs of acetabula. Excretory pore surrounded by sclerotized ring.

Remarks

This genus was erected by Cook (1986) for an unusual species from New South Wales known only from a single male. Two additional species have recently been collected and are described below. The genus has a wide, apparently disjunct distribution in Australia, with separate species known from northeastern New South Wales (*A. magnisetus*), northern Australia (*A. himonius*) and southwestern Australia (*A. barmutai*) (Figure 10).

Australotiphys magnisetus Cook
Figures 10–12

Australotiphys magnisetus Cook, 1986: 202, figs 1059–1060, 1062–1068.



Figures 7–9 *Larri laffa* sp. nov., holotype ♂: 7, left leg I; 8, left leg IV; 9, right pedipalp. Scale lines = 100 μm.

Figure 10 Map of Australia showing known distributions of *Larri* and *Australotiphys* spp.

Material Examined

Holotype

♂, Collins Creek at Collins Creek Road, 4 km N. of Wiangaree, New South Wales, Australia [28°29'S, 152°58'E], 21 April 1981, D.R. Cook (NMV K580; SL).

Diagnosis

Tibia and metatarsus of male leg IV with thickened setae. Male with ventral shield extending from coxae; glandularia lg1 and vg3 not situated in ventral shield; glandularia vgx situated in ventral shield.

Description

Adult Male

See Cook (1986). Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia; lg1 and vg3 situated on dorsum (Figures 11–12).

Remarks

This species is only known from the holotype male, and differs from *A. himonius* by the positions of lg1 and vg3. The description by Cook (1986) of the holotype is complete and need not be repeated here, but figures are presented to allow for identification of the glandularia.

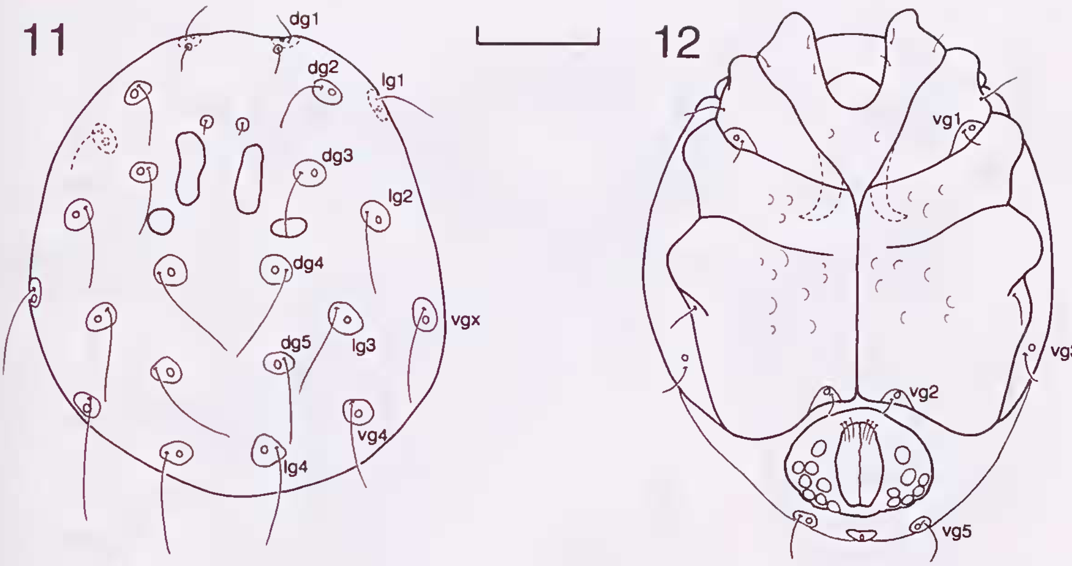
Australotiphys himonius sp. nov.

Figures 10, 13–22

Material Examined

Holotype

♂, small spring near Roper River on road to Moroak, Northern Territory, Australia [*ca.* 14°50'S,



Figures 11–12 *Australotiphys magnisetus* Cook, holotype ♂: 11, dorsal aspect; 12, ventral aspect. Scale line = 100 µm.

133°35'E], 5 July 1987, M.S. Harvey, A.L. Yen (NMV K866; SL).

Paratypes

Australia: **Northern Territory:** 1♀, same data as holotype (NMV K867; SL). **Queensland:** 1♀, creek 13 km W. of Paluma on road to Hidden Valley, 19°00'S, 146°06'E, 8 July 1986, M.S. Harvey, P.J. Vaughan (NMV K868; SL).

Diagnosis

Tibia and metatarsus of male leg IV with thickened setae. Male and female with ventral shield extending from coxae; glandularia lg1, vg3 and vgx situated in ventral shield.

Description

Adult

Colour pale yellow. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia; lg1 and vg3 situated in ventral shield (Figures 14, 17). Dorsum (Figures 13, 16): with 2 pairs of dorsalia posterior to the postocularia. Venter (Figures 14, 17): coxae fused into single plate; apodemes of coxa I nearly extending to posterior edge of coxa III; coxae I fused in mid-line; suture lines between coxae III and IV not reaching mid-line, extending laterally; sclerotized area present posterior to the coxae extending nearly to posterior level of genital field. Genital region (Figures 15, 18): 9–10 pairs of circular acetabula; 4 (♂), 3 (♀) pairs of small setae present on anterior portion of acetabular plates. Chelicera not examined. Pedipalp (Figure 22): tibia with 2 ventral setae situated in tubercles, and a single distal, medial seta. Legs (Figures 19–21): unmodified; without swimming setae, but with long, often thick, setae on many segments; male tibia and metatarsus IV with several expanded setae.

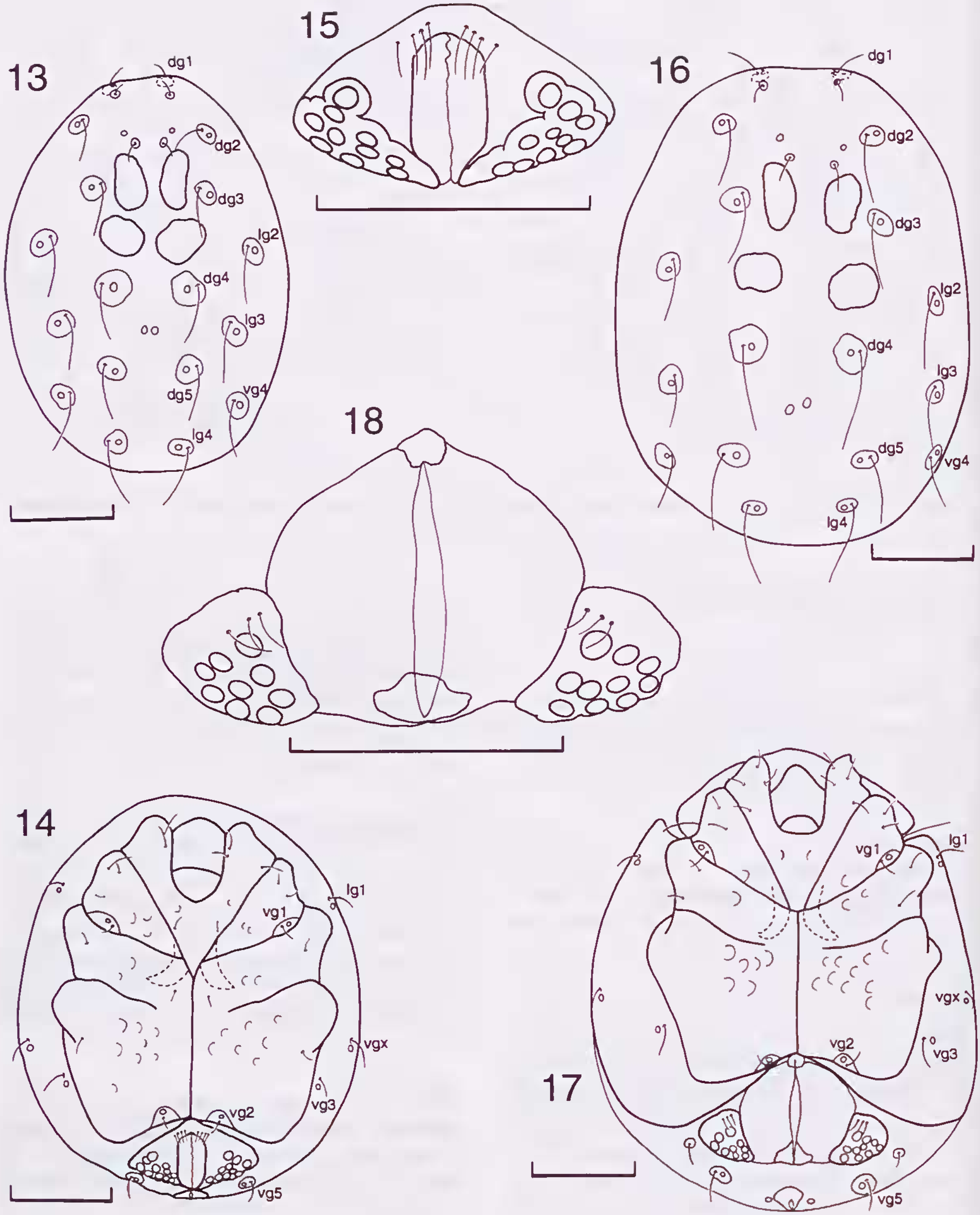
Dimensions (µm), ♂ (♀): body 381/283 (461–480/339–384); capitulum length 68 (64); genital field 71/118 (115–122/158–192). Pedipalp: trochanter 23 (22), femur 72 (70–72), patella 33 (30–33), tibia 81 (80–84), tarsus 30 (30–32). Leg I: trochanter 51 (48), femur 59 (54–56), patella 86 (77–80), tibia 128 (105–111), metatarsus 143 (126–128), tarsus 128 (118–124). Leg IV: trochanter 72 (69), femur 68 (69), patella 86 (81–89), tibia 84 (110–114), metatarsus 87 (123–127), tarsus 161 (128–132).

Remarks

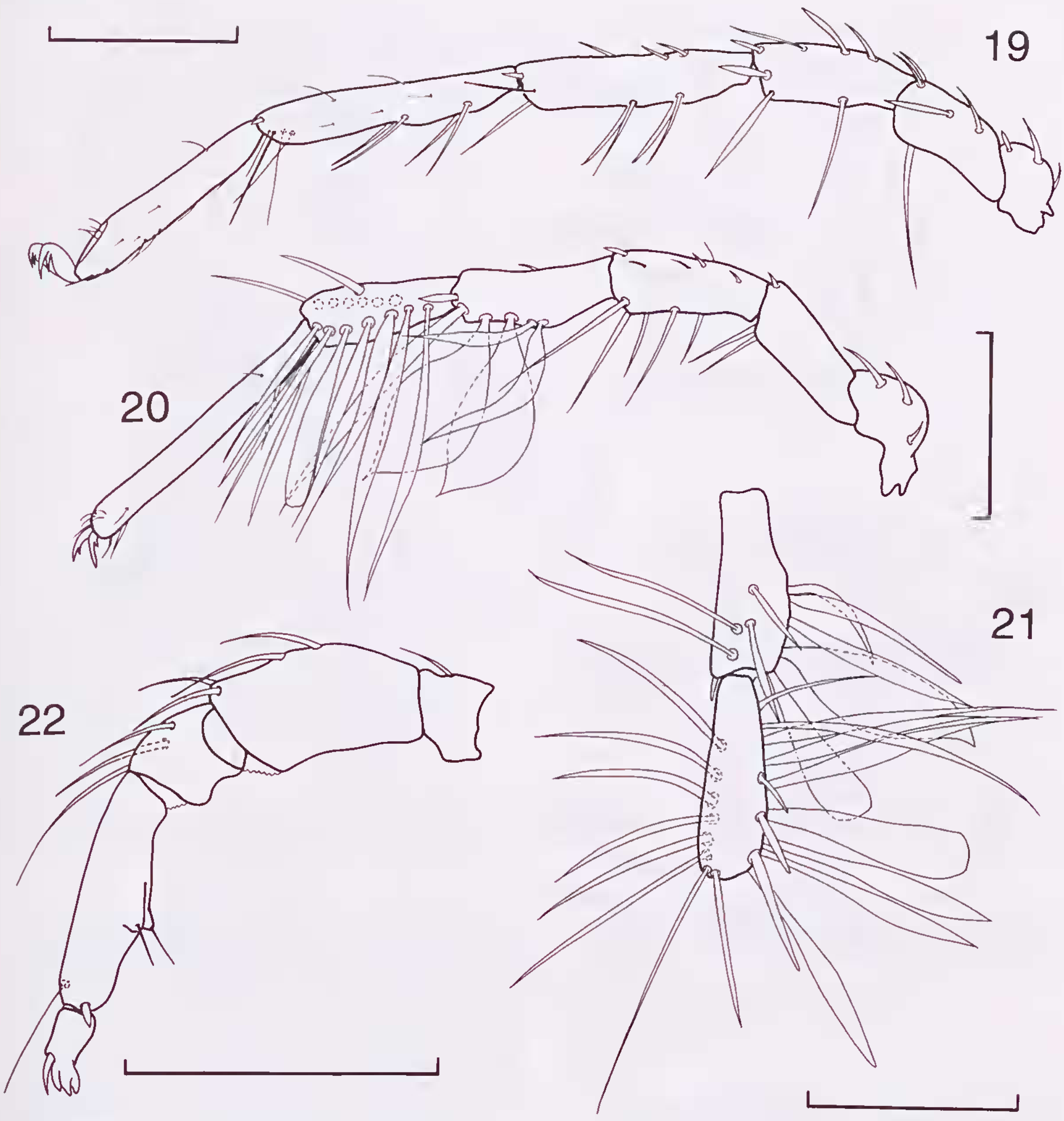
This widespread species (Figure 10) is very similar to *Australotiphys magnisetus*, but males differ in the position of lg1 and vg3. In *A. himonius* they are situated on the sclerotized area above the coxae, whereas in *A. magnisetus* they lie free in the integument.

Etymology

The specific epithet is loosely derived from the name of the type locality (*himonia* Greek, rope of a well).



Figures 13–18 *Australotiphys himonius* sp. nov.: 13–15, holotype ♂: 13, dorsal aspect; 14, ventral aspect; 15, genital field; 16–18, paratype ♀: 16, dorsal aspect; 17, ventral aspect; 18, genital field. Scale lines = 100 μm.



Figures 19–22 *Australotiphys himonius* sp. nov., holotype ♂: 19, left leg I; 20, left leg IV; 21, right tibia and metatarsus IV, ventral aspect; 22, right pedipalp. Scale lines = 100 μm.

Australotiphys barmutai sp. nov.
Figures 10, 23–31

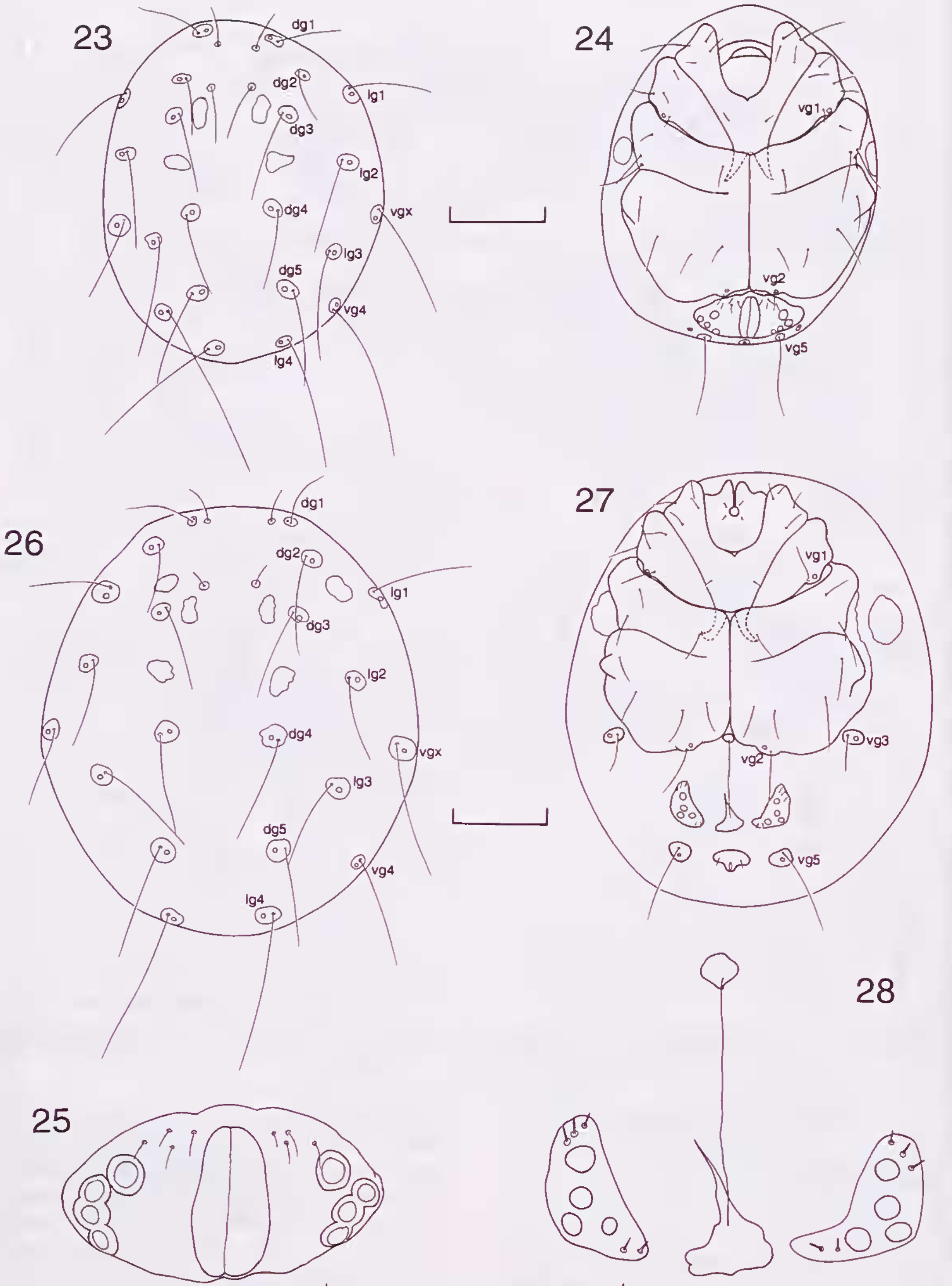
Material Examined

Holotype

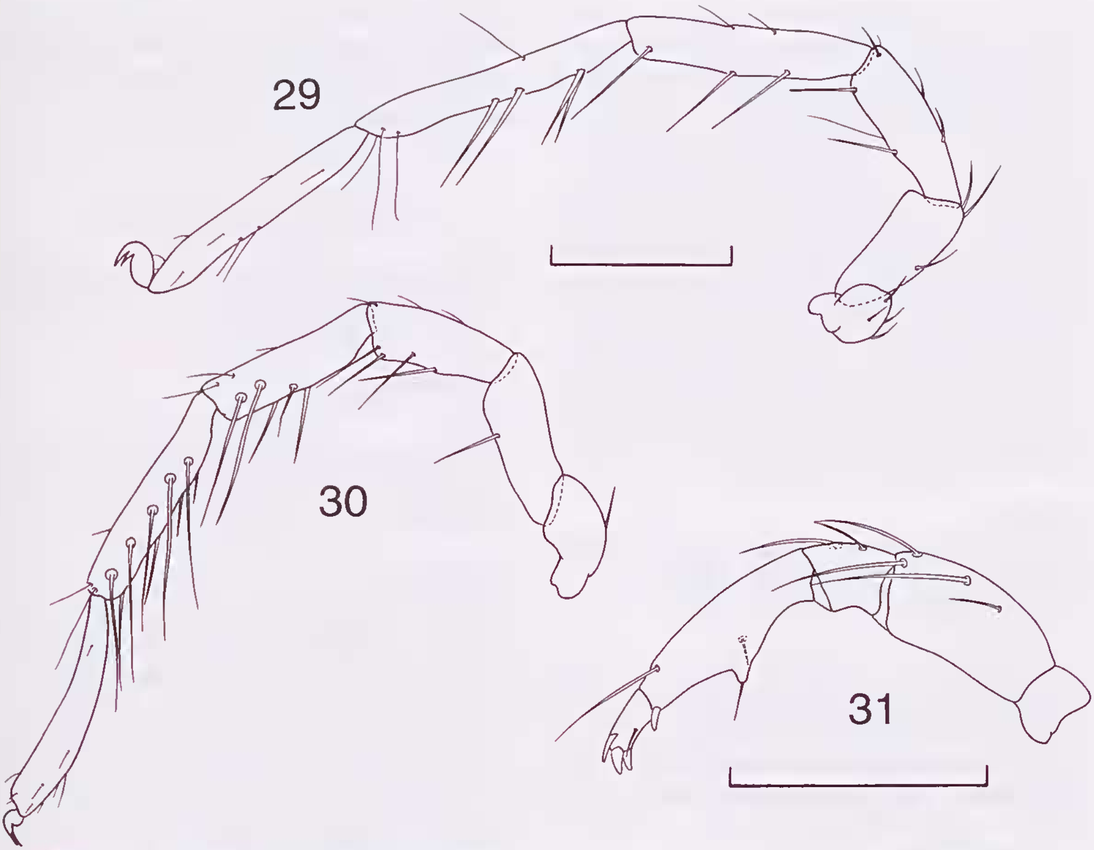
♂, Margaret River on Great North Road, Western Australia, Australia, 33°53'S, 115°18'E, 1–2 September 1985, M.S. Harvey, T.J. Doeg (WAM 94/2003; SL).

Paratypes

Australia: Western Australia: 18♂, 21♀, 3 deutonymphs, same data as holotype (WAM 94/2004–2045; SL, FL); 6♂, 6♀, 1 deutonymph, same data as holotype (NMV; FL); 2♂, 2♀, same data as holotype (ANIC; FL); 2♂, 2♀, same data as holotype (DCC; FL); 2♂, 2♀, same data as holotype (CNC; FL); 1♀, same data as holotype except 27 August 1987, M.S. Harvey, J.D. Blyth (NMV K891; FL); 4♂, 6♀, Serpentine River below Serpentine Falls, Serpentine Falls Natl Park, 32°23'S, 116°04'E, 24 August 1987, M.S. Harvey, J.D. Blyth, L.A. Barmuta (WAM 94/2046–2055; FL).



Figures 23–28 *Australotiphys barmutai* sp. nov.: 23, dorsal aspect, holotype ♂; 24–25, paratype ♂: 24, ventral aspect; 25, genital field; 26–28, paratype ♀: 26, dorsal aspect; 27, ventral aspect; 28, genital field. Scale lines = 100 µm.



Figures 29–31 *Australotiphys barmutai* sp. nov., holotype ♂: 29, right leg I; 30, right leg IV; 31, right pedipalp. Scale lines = 100 µm.

Other Material

Australia: Western Australia: 1♀, Barrabup Pool near Nannup [33°57'S, 115°41'E], 1 September 1985, M.S. Harvey, T.J. Doeg (NMV K1019; SL); 1♂, The Cascades, 8 km SSW. of Pemberton, 34°30'S, 116°00'E, 2 September 1985, M.S. Harvey, T.J. Doeg (NMV K1005; SL); 3♂, 10♀, same data except 29 August 1987, M.S. Harvey, J.D. Blyth (NMV K1006–1018; FL); 19♂, 5♀, 2 deutonymphs, same data except 3 May 1990, M.S. Harvey, J.M. Waldock (WAM 94/2056–2081; FL); 2♂, 1♀, Gardner R. at Chesapeake Rd, 34°48'S, 116°11'E, 1 May 1990, M.S. Harvey, J.M. Waldock (WAM 94/2082–2084; FL); 6♂, 1♀, Dog Pool on Shannon River, 20 km S. of Shannon, 34°46'S, 116°22'E, 29 August 1987, M.S. Harvey, J.D. Blyth (WAM 94/2085–2091; FL); 12♂, 21♀, 1 deutonymph, same data except 27–30 April 1990, M.S. Harvey, J.M. Waldock (WAM 94/2092–2125; FL); 3♂, 25♀, 2 deutonymphs, Lake Yeagarup, 18 km SW. of Pemberton, 34°33'S, 115°43'E, 29 August 1987, M.S. Harvey, J.D. Blyth (WAM 94/2126–2155; FL); 11♂, 8♀, same data except 3 May 1990, M.S. Harvey, J.M. Waldock (WAM 94/2156–2174; FL).

Diagnosis

Tibia and metatarsus of male leg IV without thickened setae. Ventral shield absent; 2 pairs of lateralia.

Description

Adult

Colour pale brown-yellow. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia; ventral shield absent (Figures 24, 27). Dorsum (Figures 23, 26): with 2 pairs of dorsalia posterior to the postocularia. Venter (Figures 24, 27): coxae not fused into single plate; apodemes of coxa I nearly extending to posterior edge of coxa III; coxae I fused in mid-line; suture lines between coxae III and IV not reaching mid-line, extending laterally; sclerotized area not present posterior to the coxae; 2 pairs of lateralia. Genital region (Figures 25, 28): 4 pairs of circular acetabula; each acetabular plate with 4 small setae on anterior portion (♂), or 3 anterior and 2 posterior small setae. Chelicera not examined. Pedipalp (Figure 31): tibia with 2 ventral setae situated in tubercles, and a single distal, medial seta. Legs (Figures 29–30): unmodified; tibiae and metatarsi with 1–4 very slender swimming setae, and with long, often thick, setae on many segments; male leg IV without thickened setae.

Dimensions (µm), ♂ (♀): body 378–394/294–314 (381–467/332–390); capitulum length 71–83 (70–80); genital field 70/99–115 (90–108/128–140). Pedipalp: trochanter 19–22 (21–22), femur 75–80 (79–81), patella 34–42 (37–42), tibia 82–93 (90–102), tarsus 27–31 (31–33). Leg I: trochanter 45–48 (45–49), femur 61–62 (58–63), patella 90–97 (92–93), tibia 123–133 (120–125), metatarsus 145–156 (138–147), tarsus 132–148 (124–138). Leg IV: trochanter 65 (71–73), femur 90–103 (74–75), patella 78–84 (93–94), tibia 96–102 (127–134), metatarsus 118–128 (141–147), tarsus 126–128 (131–142).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Dimensions (µm): body 301/270.

Remarks

Australotiphys barmutai differs from its two congeners by the lack of a ventral shield and by the lack of expanded setae on male leg IV. Under these criteria it is clearly the most plesiomorphic species of the genus. *A. barmutai* appears to be restricted to southwestern Australia (Figure 10).

Etymology

This species is named for Leon Barmuta, intrepid collector of many freshwater invertebrates.

Acercella Lundblad

Acercella Lundblad, 1941: 119; K.O. Viets, 1987: 15.

Type species

Acercella falcipes Lundblad, 1941, by original designation.

Diagnosis

Leg III of male with tarsus swollen and with dissimilar claws; leg IV of male with metatarsus with a large, dorsal or dorso-distal blade extending over tarsus. Body of male with accessory sclerotization near genital field. Genital field with 3 pairs of acetabula. Excretory pore surrounded by sclerotized ring.

Remarks

The addition of a second species to this endemic Australian genus neccesitates the alteration of the generic diagnosis provided by Cook (1974). In particular, the shape of coxae IV of the male: in *A. falcipes* the fourth coxae are nearly triangular, and the posterior margin of the coxal plate is virtually v-shaped (Figure 33); in *A. poorginup* the fourth coxae are rectangular, and the posterior margin of the coxal plate is transverse (Figure 43).

Acercella falcipes Lundblad
Figures 32–41, 52

Acercella falcipes Lundblad, 1941: 119; Lundblad, 1947: 66, figs 43a–f; K. Viets, 1956: 424; Cook, 1974: figs 1175–1176, 1190.

Material Examined

Holotype

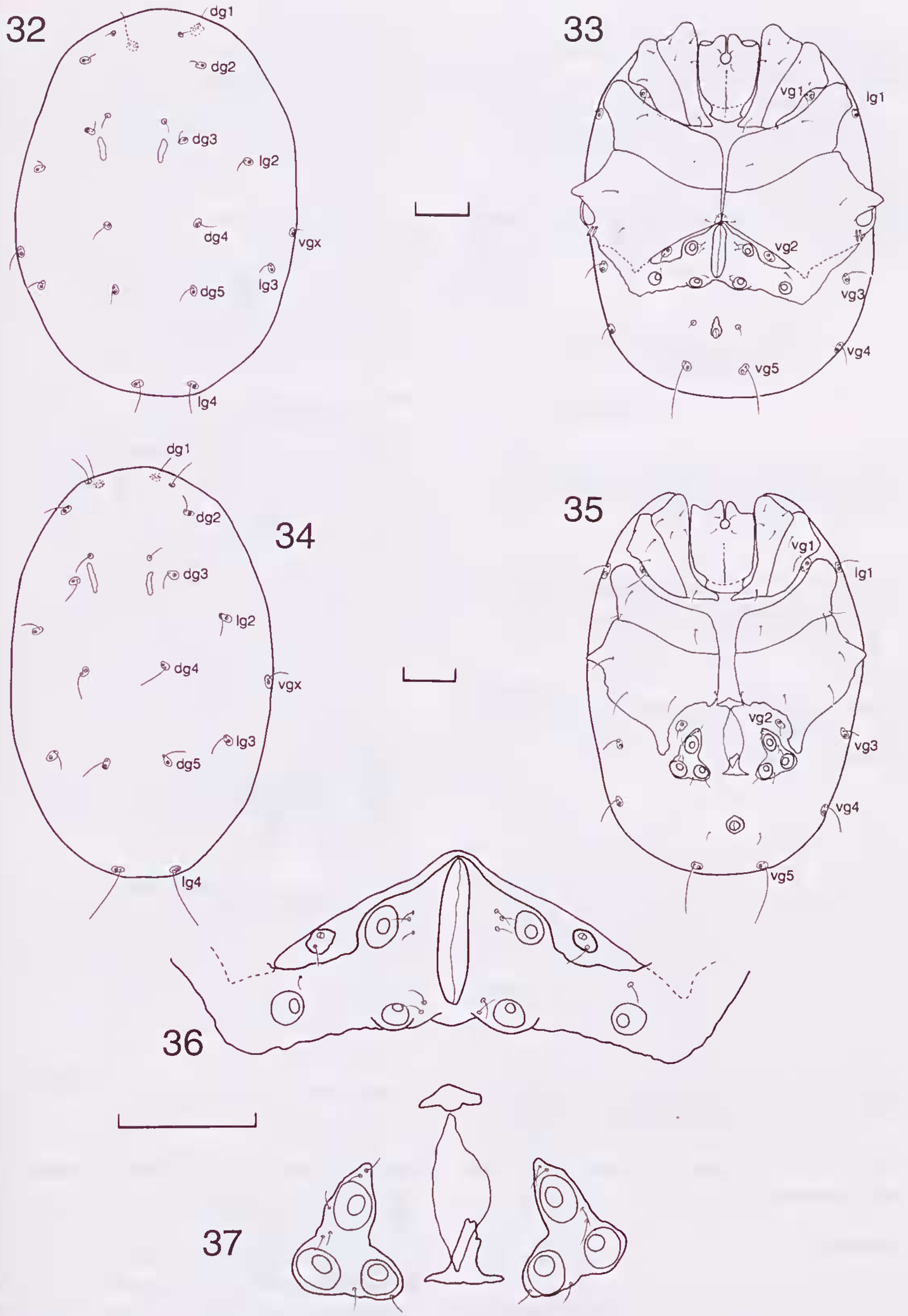
♂, Kalgoorlie, Western Australia, Australia [30°45'S, 121°28'E], cement dam, 14 January 1937, F. Linder (SMNH no. 2939; SL).

Other Material

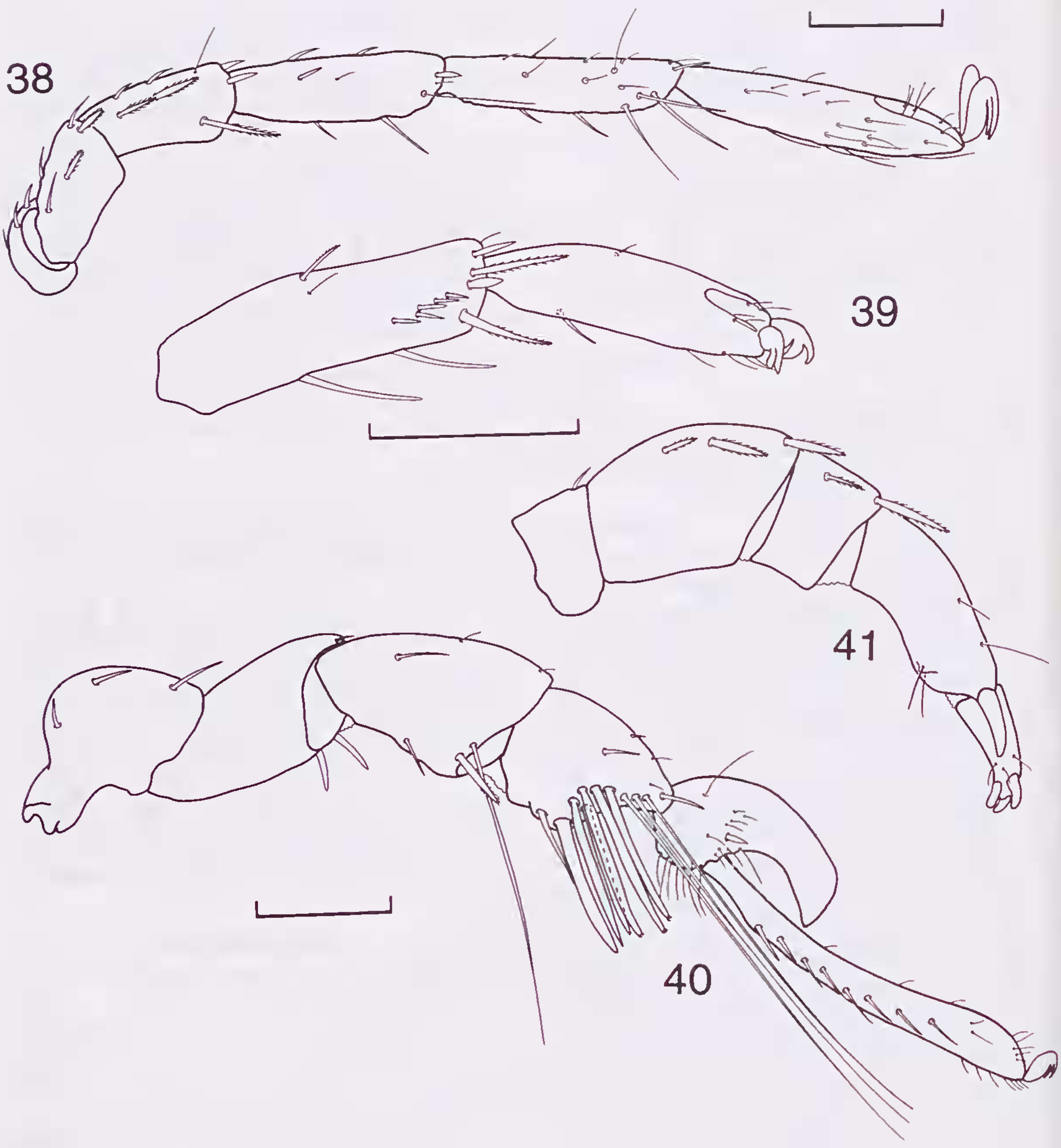
Australia: Victoria: 2♂, 2♀, 117 deutonymphs, swamp on Delegate River, Tea Tree Flat, 37°15'S, 148°50'E, 6 April 1985, D. Cook, M.S. Harvey, A. Boulton (NMV; SL, FL); 1♂, 4♀, Lake Lalbert, near Kerang [35°40'S, 143°19'E], 20 January 1989, S. Fleming (WAM; FL); 22♀, Meyers Creek at Raywood [36°32'S, 144°12'E], 27 September 1985, C. Yule (NMV; FL); 3♂, 3 deutonymphs, Meyers Creek, 4 km WNW. of Raywood [36°30'S, 144°10'E], 5 November 1985, M.S. Harvey, B.J. Scott, L.A. Hoare (NMV; SL); 1 ♀ (labelled as allotype by Lundblad), Mt Macedon [37°23'S, 144°35'E], 27 September 1936, F. Linder (SMNH no. 3401; SL); 6♀, Tragowel Swamp, near Kerang [35°49'S, 143°57'E], 7 June 1989, S. Fleming (WAM; FL). **Western Australia:** 1♀, 1 deutonymph, lakes on Boat Harbour Road, 8 km WSW. of Parryville, 35°01'S, 117°07'E, 30 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/3010–3011; FL); 1♀, Lake Pleasant View, 4 km NE. of Manypeaks, 34°50'S, 118°11'E, 2 September 1987, M.S. Harvey, J.D. Blyth (NMV; FL); 18♂, 6♀, swamp in Melaleuca Park, 31°42'S, 115°57'E, 25 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/2990–3002, NMV; SL, FL); 11♂, 14♀, North Lake, Perth, 32°05'S, 115°49'E, 21 August 1987, M.S. Harvey (1♂, 1♀ each in DCC, CNC, remainder in WAM 88/3003–3009, NMV; FL); 2♂, same locality, January 1986, S. Rolls (WAM 88/3012–3013; FL); 1♀, 2 deutonymphs, Wallaroo Rock, 8 km N. of Wallaroo Siding [30°48'S, 120°29'E], 23 August 1985, M.S. Harvey, T.J. Doeg, R. Marchant (NMV; SL); 1♂, Thompson Lake [32°09'S, 155°50'E], south end, 30 August 1985, M.S. Harvey, T.J. Doeg, B. Murley (NMV; SL).

Diagnosis

Pedipalpal tibia with 2 small ventral setiferous



Figures 32–37 *Acercella falcipes* Lundlad: 32, dorsal aspect, ♂; 33, ventral aspect, ♂; 34, dorsal aspect, ♀; 35, ventral aspect, ♀; 36, genital field, ♂; 37, genital field, ♀. Scale lines = 100 μm.



Figures 38–41 *Acercella falcipes* Lundlad, ♂: 38, right leg I; 39, right leg III, metatarsus and tarsus; 40, right leg IV; 41, left pedipalp. Scale lines = 100 µm.

tubercles. Male metatarsus IV with dorsal blade-like expansion very thick.

Description

Adult

Colour yellow-brown, legs reddish. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia present (Figures 32–35). Dorsum (Figures 32, 34): with a pair of poorly defined dorsalia. Venter (Figure 33, 35): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV antero-laterally. Genital region (Figures 36, 37): 3 pairs of large, equally sized acetabula. Chelicera not examined. Pedipalp (Figure 41): tibia with 2 disto-ventral setae set in small tubercles, and with disto-dorsal seta; tarsus with 4 disto-dorsal setae. Legs (Figures 38–40): ♂ tarsus III with shortened and thickened tarsus, and with unequal claws, posterior claw shortest (Figure 39); ♂ metatarsus III with row of spatulate setae on posterio-distal margin; ♂ patella and tibia IV thickened, tibia with 6 stout forward-projecting thick setae on postero-ventral margin; ♂ metatarsus IV with large, thick protuberance extending over tarsus, about one-third as long as tarsus, concave edge of metatarsus with several small spinules (Figure 40); legs II, III and IV with swimming setae arranged as follows: leg II: ♂, tibia 2–4, metatarsus 2–3; ♀, tibia 2–4, metatarsus 4; leg III: ♂, patella 0–2, tibia 6–8, metatarsus 0; ♀, patella 0–2, tibia 4–5, metatarsus 5; leg IV: ♂, patella 0–1, tibia 3–5; ♀, patella 0–3, metatarsus 5–7, tarsus 6–8.

Dimensions (µm), ♂ (♀): body 565–710/455–586 (730–1064/518–604); capitulum length 147–173 (179–195); chelicera length 200 (?); genital field 118–134/288–294 (159–243/248–346). Pedipalp: trochanter 38–43 (41–50), femur 89–103 (106–121), patella 44–56 (58–65), tibia 80–105 (111–122), tarsus 60–71 (65–72). Leg I: trochanter 70–88 (77–83), femur 71–90 (82–96), patella 99–121 (128–135), tibia 141–163 (179–189), metatarsus 147–180 (197–205), tarsus 192–230 (202–250). Leg III: metatarsus 160–200, tarsus 127–144. Leg IV: trochanter 138–160 (128–149), femur 108–134 (110–125), patella 138–186 (173–186), tibia 122–163 (224–232), metatarsus 130–147 (250–261), tarsus 237–288 (237–275).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Dimensions (µm): body 448/352.

Remarks

Lundblad (1941 and several other papers) did not make valid holotype designations or restriction of type localities for many species, and there is some doubt as to the type status of the female specimen from Mt Macedon, Victoria which he had labelled as the allotype. As this locality was not mentioned in the original publication, I treat it as not part of the type series, which is restricted to the holotype from Kalgoorlie.

Males of *A. falcipes* differ from those of *A. poorginup* by the shape of the fourth leg and the lack of sclerotization posterior to the genital field. Both males and females differ by the lack of ventral setiferous tubercles on the pedipalpal tibia. *Acercella falcipes* is a remarkably widespread species (Figure 52), and only slight differences in size could be detected between eastern and western populations. The distribution conforms quite well to a Bassian distribution, and the species may eventually be found in suitable habitats in Tasmania.

During August 1987, several pairs collected from North Lake, W.A., were transferred to watch-glasses in the laboratory where mating was observed. The male approached the female and, with their ventral surfaces in contact, he clasped the female's fourth leg between the tarsus and the distal extension of the tarsus of his fourth leg. He then collected the spermatophore from his gonopore with his cupped third tarsi, and transferred it into the female's gonopore. These constitute the first observations on mating in the genus.

Acercella poorginup sp. nov.
Figures 42–52

Material Examined

Holotype

♂, Poorginup Swamp, Western Australia, Australia, 34°33'S, 116°44'E, 4 September 1985, M.S. Harvey, T.J. Doeg (WAM 88/2943; SL).

Paratypes

Australia: Western Australia: 1♂, 1♀, same data as holotype (WAM 88/2944–2945; SL); 1♂, 1♀, same data as holotype (NMV K896–897; SL).

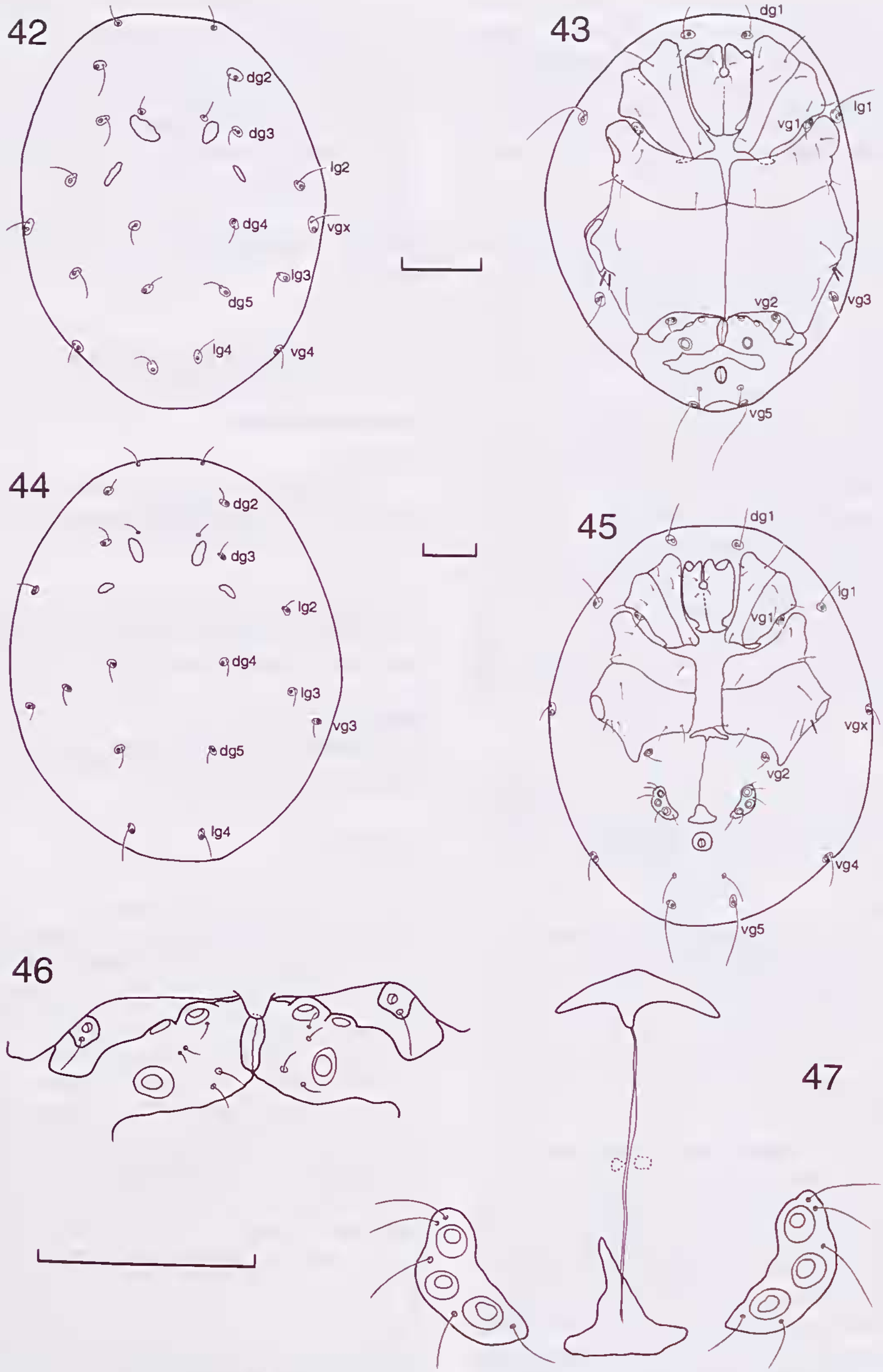
Diagnosis

Pedipalpal tibia with 2 large ventral setiferous tubercles. Male metatarsus IV with dorsal blade-like expansion very thin.

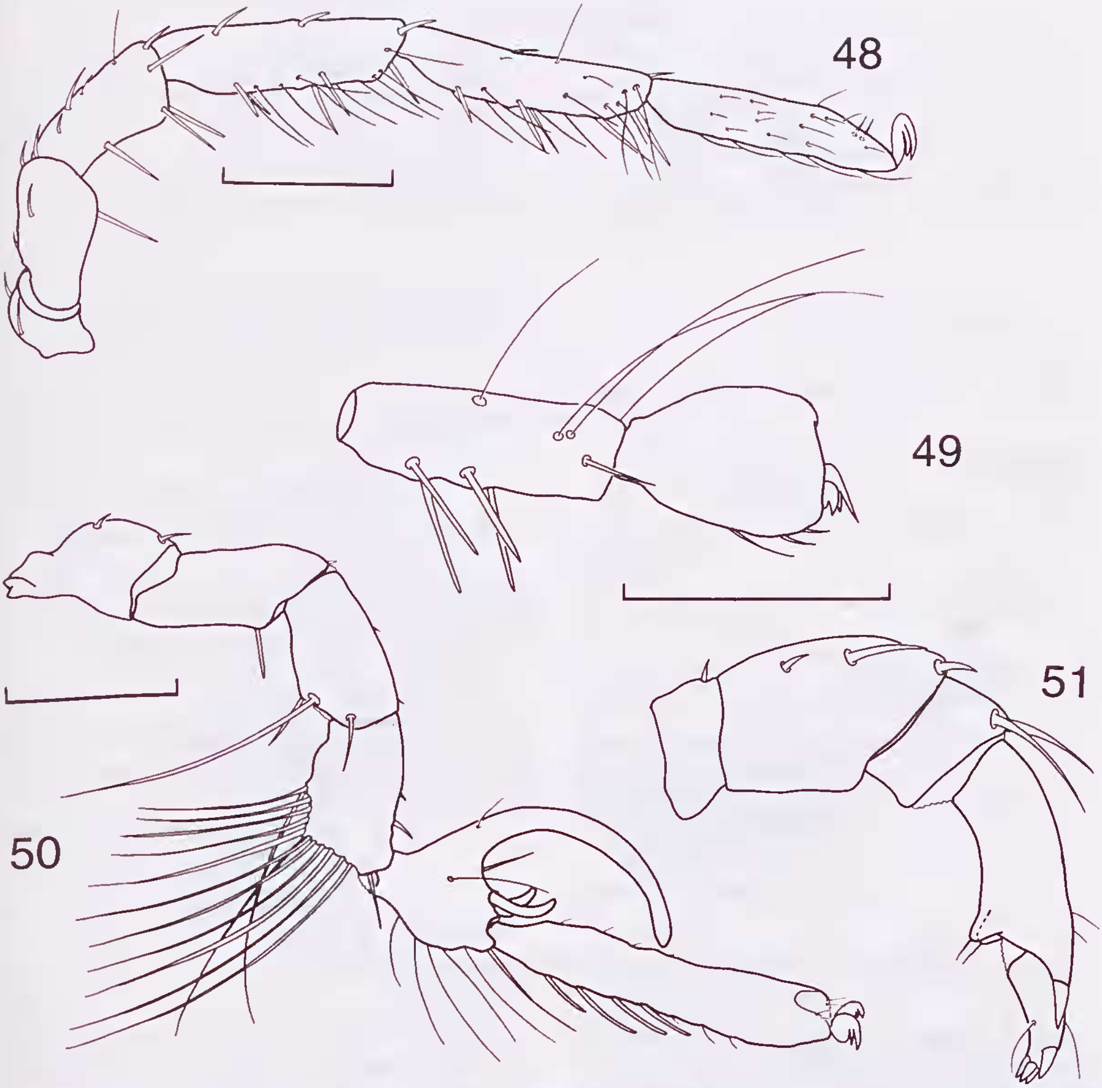
Description

Adult

Colour deep red. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia present (Figures 42–45). Dorsum (Figures 42, 44): with 2 pairs of dorsalia, anterior pair larger than posterior pair. Venter (Figures 43, 45): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV extending laterally (♂) or antero-laterally (♀). Genital region (Figures 46, 47): 3 pairs of acetabula; those of ♂ unequal in size, the posterior pair larger than remaining pairs; those of ♀ virtually in a straight line. Chelicera not examined. Pedipalp (Figure 51): tibia with 2 large disto-ventral setiferous tubercles, and with disto-dorsal seta; tarsus with 4 disto-dorsal setae. Legs (Figures 48–50): ♂ tarsus III extremely shortened and thickened, and with unequal claws, posterior claw shortest (Figure 49); ♂ tibia and metatarsus IV modified, tibia with fan-shaped arrangement of swimming hairs on ventral surface, and metatarsus with large dorsal extension curving over tarsus,



Figures 42–47 *Acercella poorginup* sp. nov.: 42, dorsal aspect, holotype ♂; 43, ventral aspect, holotype ♂; 44, dorsal aspect, paratype ♀; 45, ventral aspect, paratype ♀; 46, genital field, holotype ♂; 47, genital field, paratype ♀. Scale lines = 100 μm.



Figures 48–51 *Acercella poorginup* sp. nov., holotype ♂: 48, right leg I; 49, right leg III, metatarsus and tarsus; 50, right leg IV; 51, left pedipalp. Scale lines = 100 µm.

disto-dorsal end with 2 stout, blunt, slightly curved setae (Figure 50); legs II, III and IV with swimming setae arranged as follows: leg II: ♂, tibia 3, metatarsus 2–3; ♀, tibia 3, metatarsus 3; leg III: ♂, patella 2, tibia 5–6, metatarsus 2–3; ♀, patella 2, tibia 4, metatarsus 4; leg IV: ♂, patella 1, tibia 10–13; ♀, patella 1, metatarsus 5–8, tarsus 5–7.

Dimensions (µm), ♂ (♀): body 512–544/365–390 (774–781/621–659); capitulum length 121–134 (135–141); genital field 52/142 (173–185/196–198). Pedipalp: trochanter 30–35 (33–34), femur 86–93 (91–95), patella 41–49 (43–49), tibia 94–102 (104–111), tarsus 55–62 (64–68). Leg I: trochanter 64–69 (62), femur 70–79 (58–67), patella 100–108 (87–95), tibia 153–164 (135–147), metatarsus 150–167 (140–147), tarsus 152–167 (142–149). Leg III: metatarsus 111–113, tarsus 81–83. Leg IV: trochanter 100–113 (96–99), femur 94–98 (84–95), patella 94–102 (108–122), tibia 101–117 (154–172), metatarsus 84–92 (172–188), tarsus 211–221 (157–173).

Remarks

Acercella poorginup differs from *A. falcipes* by possessing two large setiferous tubercles on the pedipalpal tibia. Males further differ by the shape of the fourth leg and by the presence of sclerotization posterior to the genital field.

At present, this species has been collected only in

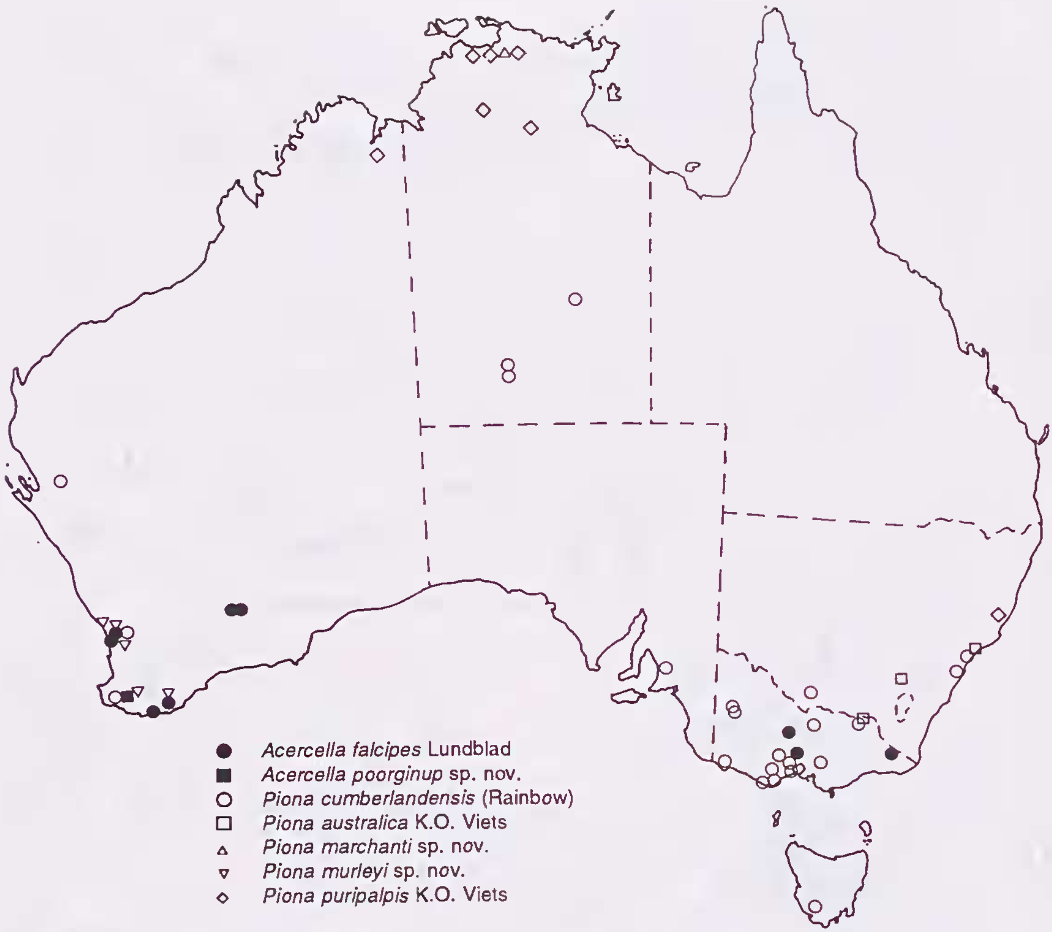


Figure 52 Map of Australia showing known distributions of *Acercella* and *Piona* spp.

Poorginup Swamp, W.A. (Figure 52). I revisited the type locality during August 1987, and found that the swamp had dried to a muddy quagmire which apparently sustained no macroinvertebrate fauna. Limited attempts were made to dig into the mud to ascertain whether nymphal mites had moved down into the hyporheion, but these proved unsuccessful. Due to the clearing of the natural vegetation around the swamp for farmland, there is a serious threat that if the swamp does refill at a later date, it could simply refill with saline water, as has at least one other lake in the Lake Muir complex (of which Poorginup is the smallest and most pristine). Like *Pseudohydryphantes doegi* Harvey (Harvey 1987), *Acercella poorginup* has not been collected at any other site, despite a fairly large collecting effort in the southwest over recent years, and it is possible that both species are extinct.

This species has recently been placed on Schedule 1 of the Protected Invertebrate Fauna under the Wildlife Conservation Act 1950 (Minson 1994).

Etymology

The specific epithet is a noun in apposition taken from the type locality.

Subfamily Pioninae Thor

Piona Koch

Nesaea Koch, 1836: 21. Junior homonym of *Nesaea* Leach, 1814 (Crustacea) and *Nesaea* Risso, 1826 (Mollusca). Type species: *Nesaea rosea* Koch, 1836, by subsequent designation of Koch (1842).

Piona Koch, 1842: 13; K.O. Viets, 1987: 605. Type species: *Nesaea ovata* Koch, 1836 (junior subjective synonym of *Nesaea variabilis* Koch, 1836), by subsequent designation of Koch (1842).

Curvipes Koenike, 1891: 20. Replacement name for *Nesaea* Koch, 1836. Synonymised by Wolcott (1905).

Piona (Dispersipiona) K. Viets, 1926: 194. Type species: *Hydrachna clavicornis* Müller, 1776, by original designation. Synonymised by Cook (1960).

Piona (Tetrapiona) K. Viets, 1926: 194. Type species: *Nesaea variabilis* Koch, 1836, by original designation. Synonymised by Cook (1960).

Piona (Carnepiona) Besseling, 1959: 22. Type species: *Nesaea carnea* Koch, 1836 by original designation. Synonymised by Cook (1974).

Piona (Pusillopiona) Besseling, 1959: 22. Type species: *Nesaea pusilla* Neuman, 1875 by original designation. Synonymised by Cook (1974).

Piona (Conglopiona) Besseling, 1959: 22. Type species: *Nesaea conglobata* Koch, 1836 by original designation. Synonymised by Cook (1974).

Diagnosis

Male tarsus III with dissimilar claws; tibia IV of male with concavity lined with small, blunt setae. Body without accessory sclerotization. Genital field with many pairs of acetabula. Excretory pore surrounded by sclerotized ring.

Remarks

Due to the large number of described *Piona* species, and a certain amount of variation within the genus, several authors have erected subgenera. The history and status of these names was summarized by Cook (1974) who noted that their use was hazardous due to gradations between species. Smith (1976) adopted a more reasonable approach, and erected a series of species-group categories.

Piona cumberlandensis (Rainbow)

Figures 52–54

Atax cumberlandensis Rainbow, 1906: 160, fig. 37 (in part).

Unionicola cumberlandensis (Rainbow): Walter, 1928: 59; K. Viets, 1956: 360.

Unionocola [sic] *cumberlandensis* (Rainbow): K. Viets, 1932: 364;

Unionicola (Hexatax) cumberlandensis (Rainbow): Halík, 1941: 103.

Piona uncatiformis Lundblad, 1941: 118. Synonymized by Cook (1986).

Piona (Piona) uncatiformis Lundblad: Lundblad, 1947: 69, figs 44a–i; K. Viets, 1956: 460.

Piona cumberlandensis (Rainbow): Cook, 1986: 201, figs 1053–1058, 1061.

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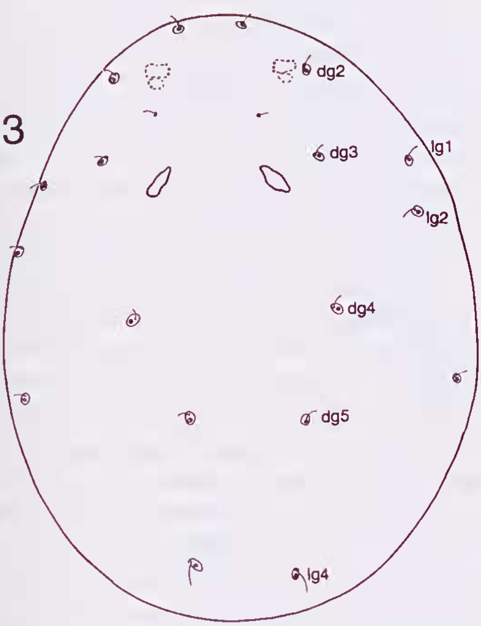

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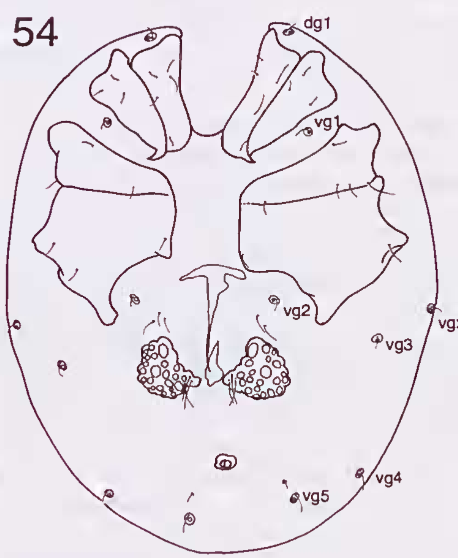


Figures 53–54 *Piona cumberlandensis* (Rainbow), ♀: 53, dorsal aspect; 54, ventral aspect. Scale line = 100 µm.

Unionicola (Unionicola) cumberlandensis (Rainbow): Vidrine, 1986: 234.

Material Examined

Lectotype of Atax cumberlandensis
♂ (present designation), Parramatta, New South Wales, Australia [33°48'S, 151°01'E], ponds, 12 June 1905, [A.R. McCulloch] (AM KS15751; FL, SL).

Paralectotypes of Atax cumberlanensis
Australia: New South Wales: 1♂, 7♀, same data as lectotype (AM KS15751; FL, SL).

Lectotype of Piona uncatiformis
♂ (designated by Lundblad (1947), see below), North Portland, Victoria, Australia [38°19'S, 141°35'E], dam, 26 November 1936, F. Linder (SMNH no. 2953; SL).

Paralectotypes of Piona uncatiformis
Australia: Victoria: 1♂, Shepparton [36°23'S, 145°24'E], May 1925, E.J. Semmens (SMNH no. 3404; SL); 1♂, 1♀, Lake Kariah [38°11'S, 143°13'E], 24 November 1936, F. Linder (SMNH no. 3403, 3405; SL).

Other Material
Australia: New South Wales: 1 ♀ (labelled 'allotypus' by Lundblad), Deniliquin [35°32'S, 144°57'E], 5 October 1936, F. Linder (SMNH no. 3402; SL); 1♂, 2♀, Lake Willeroo, 30°05'S, 145°18'E, 28 March 1989, B.V. Timms (WAM; SL); 6♂, 14♀, Newcastle [32°56'S, 151°46'E], 24 September 1986, B.V. Timms (NMV; FL); 9♀, 3 deutonymphs, Shortland Wetlands Centre bird pond, near Newcastle [32°53'S, 151°41'E], 19 March 1987, B.V. Timms (NMV; FL). **Northern Territory:** 8♂, 2♀, Kurundi Waterhole, Murchison Range [20°30'S, 134°40'E], 7 August 1979, J.D. Blyth (NMV; FL); 2♀, creekpool no. 2, Palm Valley, Finke Gorge Natl Park [24°03'S, 132°42'E], 26 July 1979, J.D. Blyth (NMV; FL); 1♀, Big Hole Ellery Gorge Nature Park [23°47'S, 133°04'E], 23 July 1979, J.D. Blyth (NMV; FL); 15♂, 19♀, same data (NMV; FL). **South Australia:** 1♀, Brighton [35°01'S, 138°31'E], 6 March 1957 (SAM N19901303; SL). **Tasmania:** 6♂, 8♀, Big Waterhouse Lake, via Bridport [40°54'S, 147°37'E], 31 January 1990, B. V. Timms (WAM; FL); 2♀, Big Waterhouse Lake [40°54'S, 147°37'E], 9 October 1991, TJK, LFM (QVM; FL); 1♂, 2♀, same locality, 15 January 1992, TJK, LFM (QVM; FL); 1♂, same locality, 18 March 1992, TJK, LFM (QVM; FL); 2♀, same locality, 15 January 1992, LFM, JG (QVM; FL); 5♀, same locality, 15 July 1992, LFM, PLP (QVM; FL); 1♀, Blackmans Lagoon [40°55'S, 147°36'E], 21 January 1992, LFM, PLP (QVM; FL); 2♂, 8♀, Bowlers Lagoon [40°52'S, 147°55'E], 23 September 1991, TJK, LFM (QVM; FL); 1♀, same locality, 6 November 1991, TJK, LFM (QVM; FL); 3♂, 6♀, 1 deutonymph, same locality, 14 January 1992, TJK, LFM (QVM; FL); 2♂, 3♀, same locality, 17 March 1992, TJK, LFM (QVM; FL); 5♀, same locality, 14 July 1992, PLP, LFM (QVM; FL); 11♀, Cambridge [42°50'S, 147°26'E], 30 July 1966, E. Aves, A.J. Dartnall (TM; FL); 2♂, 1♀, Cape Naturaliste [40°51'S, 148°44'E], 13 January 1992, TJK, LFM (QVM; FL); 5♀, same locality, 13 July 1992, L. McGowan, P. LaPalombara (QVM; FL); 8♀, Lake Leake [42°01'S, 147°50'E], November 1937, J.W. Evans (TM; FL); 52♂, 65♀, 1 deutonymphs, 1 teliophan, Lake Pedder [*ca.* 42°54'S, 146°05'E], various dates, P.S. Lake (NMV; FL); 1♀, Little Waterhouse Lake [40°53'S, 147°36'E], 15 August 1991, TJK, LFM (QVM; FL); 3♀, same locality, 9 October 1991, TJK, LFM (QVM; FL); 3♀, same locality, 18 March 1992, LFM, JKG (QVM; FL); 1♀, South Hobart [42°54'S, 147°18'E], 26 November 1985, J. Barclay (TM; FL). **Victoria:** 2♀, Acheron River at Old Coach Road, pond near river, 37°30'S, 145°41'E, 5 March 1987, M.S. Harvey (NMV; FL); 2♂, 5♀, Barwon River, E. branch of Lake Elizabeth, 12 km S. of Forrest [*ca.* 38°34'S, 143°45'E], 31 August 1975, J. Aldenhoven (NMV; FL); 1♀, same data, except 1975 (NMV; FL); 1♀, Black Flat, Wyperfeld Natl Park [35°35'S, 142°02'E], 6 April 1974, J.D. Blyth (NMV; FL); 1♀, Expedition Pass Reservoir, 1.5 km SW. of Faraday [37°03'S, 144°16'E], 5 November 1985, M.S. Harvey, B.J. Scott, L.A. Hoare (NMV; FL); 4♀, Lake Albacutya [35°45'S, 141°58'E], 9 September 1977 (NMV; FL); 8♀, Lake Modewarre [38°15'S, 144°09'E], 28 September 1966, D. Pollard (NMV; FL); 6♂, 1♀, Melba Gully Park near Laver's Hill, 30°42'S, 143°22'E, 21 May 1986, M.S. Harvey, P.J. Vaughan (NMV; FL); 4♂, 3♀, Ryan's 1 Billabong, 5 km E. of Albury [36°06'S, 147°58'E], 15 January 1988, R. Butcher (NMV; FL); 1♀, same data except 19 January 1988 (NMV; FL); 5♂, 13♀, 6 larvae, Shaws Lake, NE. of Blackwood [*ca.* 37°29'S, 144°19'E], 8 January 1986, M.S. Harvey, R. St Clair (NMV; FL); 3♂, same data except M.S. Harvey, M. Blosfelds, G.H. Southwell, C. Southwell (NMV; FL); 6♀, Snowden's Billabong, near Wodonga [36°06'S, 147°58'E], 18 February 1985 (NMV; FL). **Western Australia:** 1♀, Abydos-Woodstock Reserve, Nganaloongana Pool, 21°36'S, 118°48'E, 28 October 1990, M.S. Harvey (WAM; FL); 2♂, Bilung Pool, Congo Creek, Gascoyne Junction-Geraldton Road [25°42'S, 116°00'E], 11 November 1979, J.D. Blyth (NMV; FL); 1♀, The Cascades, 8 km SSW. of Pemberton, 34°30'S, 116°00'E, 29 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/3026; FL); 9♂, 13♀, larvae, North Lake, Perth, 32°05'S, 115°49'E, 21 August 1987, M.S. Harvey (WAM 88/3027–3036, NMV; FL).

Diagnosis

Male genital field with deep, central pit, and with 2 large acetabula and many small acetabula; female genital field with acetabula lying on 2 large plates, each plate with 2 large acetabula and many small acetabula. Pedipalpal tibia with distal thickened seta. Anterior claw of male tarsus III strongly modified.

Description

Adult

See Cook (1986). Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia and 6 pairs of ventroglandularia (Figures 53–54).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Remarks

The type material of *Atax cumberlandensis* also contains an adult specimen of *Hydrodroma monticola* (Piersig) (Hydrodromidae), and thus a lectotype of *A. cumberlandensis* is designated.

The original description of *Piona uncatiformis* by Lundblad (1941) was very brief; he simply mentioned male characters and referred to '♂' from 'Australien, Victoria'. No holotype was designated, and no specific type locality was mentioned. Subsequently, Lundblad (1947) published a more extensive redescription and referred to a 'Typus', an 'Allotypus' from New South Wales, and to various localities in Victoria from which other specimens had been collected. As no holotype was mentioned in the original publication, I have considered that the types from Victoria should be regarded as syntypes [Article 72a of the International Code of Zoological Nomenclature (third edition)], but that the restriction by Lundblad (1947) of a 'Typus' can be construed as designation of a lectotype under Article 74b of the Code. The remaining specimens from Victoria are treated as paralectotypes, but the 'allotype' from New South Wales is excluded from the type series.

The synonymy of *Piona uncatiformis* with *A. cumberlandensis* by Cook (1986) is confirmed by comparison of the type series of both species. *Piona cumberlandensis* is widely distributed in Australia (Figure 52). It belongs to the *Piona coccinea* group as defined by Smith (1976).

Mating was observed between males and females of this species during August 1987, after specimens had been taken from North Lake, W.A., and placed in watch-glasses. The female hooked her pedipalps over the tibiae IV of the male whilst upside-down. The male then transferred the spermatophore from his genital aperture to the female's aperture by cupping it between his modified tarsi III.

Piona australica K.O. Viets
Figures 52, 55–66

Piona australica K.O. Viets, 1980: 164, figs 25–31.

Types (not examined)

Holotype

♂, Lake Hume, Albury, New South Wales, Australia [*ca.* 36°10'S, 147°05'E], 13 December 1977, R. Shiel (VC).

Paratypes

Australia: New South Wales: 4 ♀ (including allotype), same data as holotype (VC); 1♀, Boorowa River [*ca.* 34°10'S, 148°48'E], 10 April 1977, R. Shiel (VC).

Material Examined

Australia: New South Wales: 12♀, Burgess Lagoon via Maitland [*ca.* 32°44'S, 151°34'E], 13 April 1984, B.V. Timms (NMV; SL, FL); 2♂, 8♀, 5 deutonymphs, Lake Hume [*ca.* 36°10'S, 147°05'E], 21 February 1991, V. Matveev (WAM; FL); 2♀, Lake McKenzie, Jervis Bay, *ca.* 35°08'S, 150°43'E, 20 January 1989, B. Timms (WAM; FL). **Western Australia:** 1♂, 8♀, pools in Rudall River, Great Sandy Desert, *ca.* 22°20'S, 122°00'E, 23 March 1988, R. Hart (WAM 88/3014–3018, NMV; SL, FL).

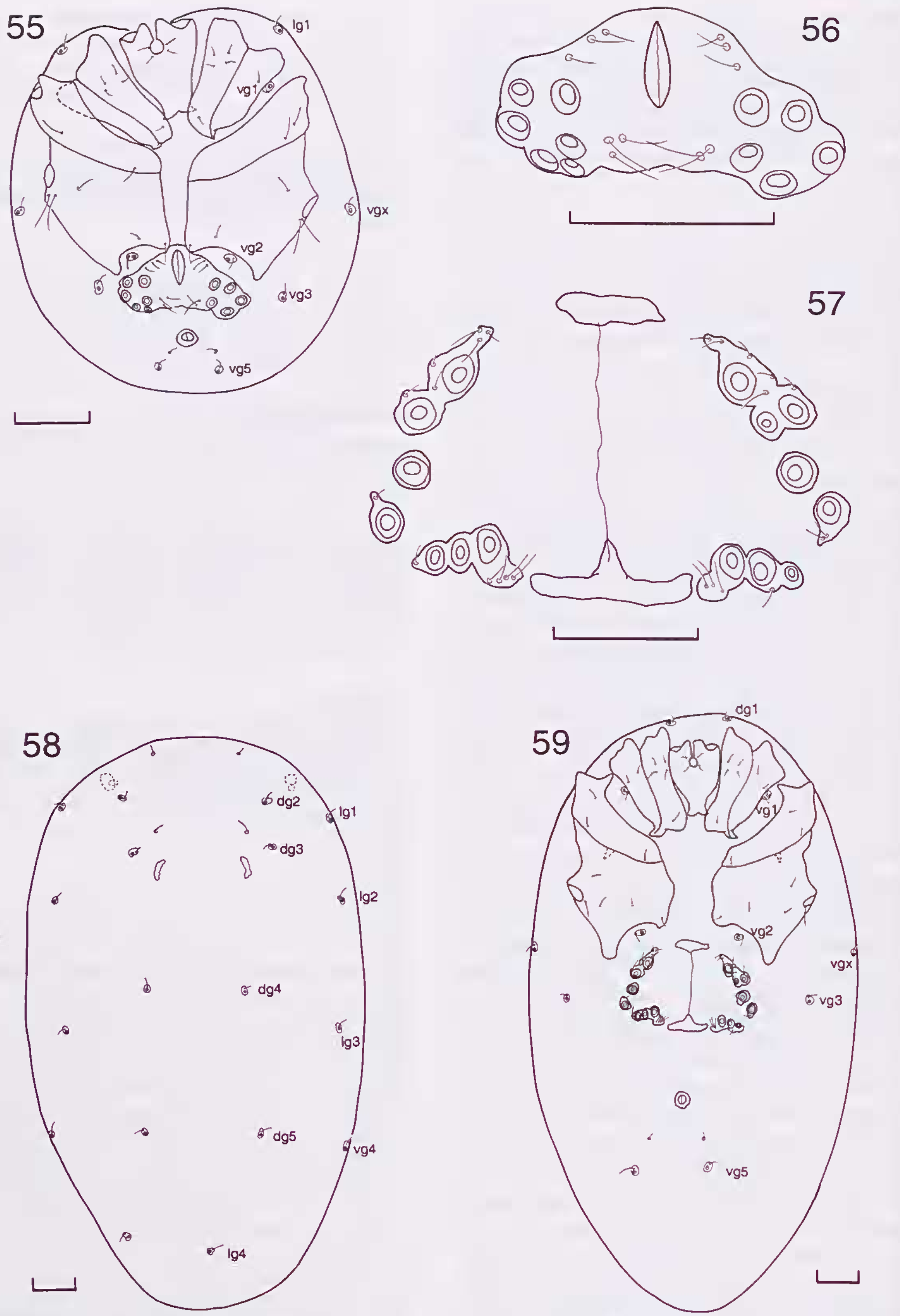
Diagnosis

Male genital field without deep, central pit; female genital field with acetabula lying on small, scattered plates. Pedipalpal tibia with stout, distal seta. Anterior claw of male tarsus III strongly curved, without ventral clawlet.

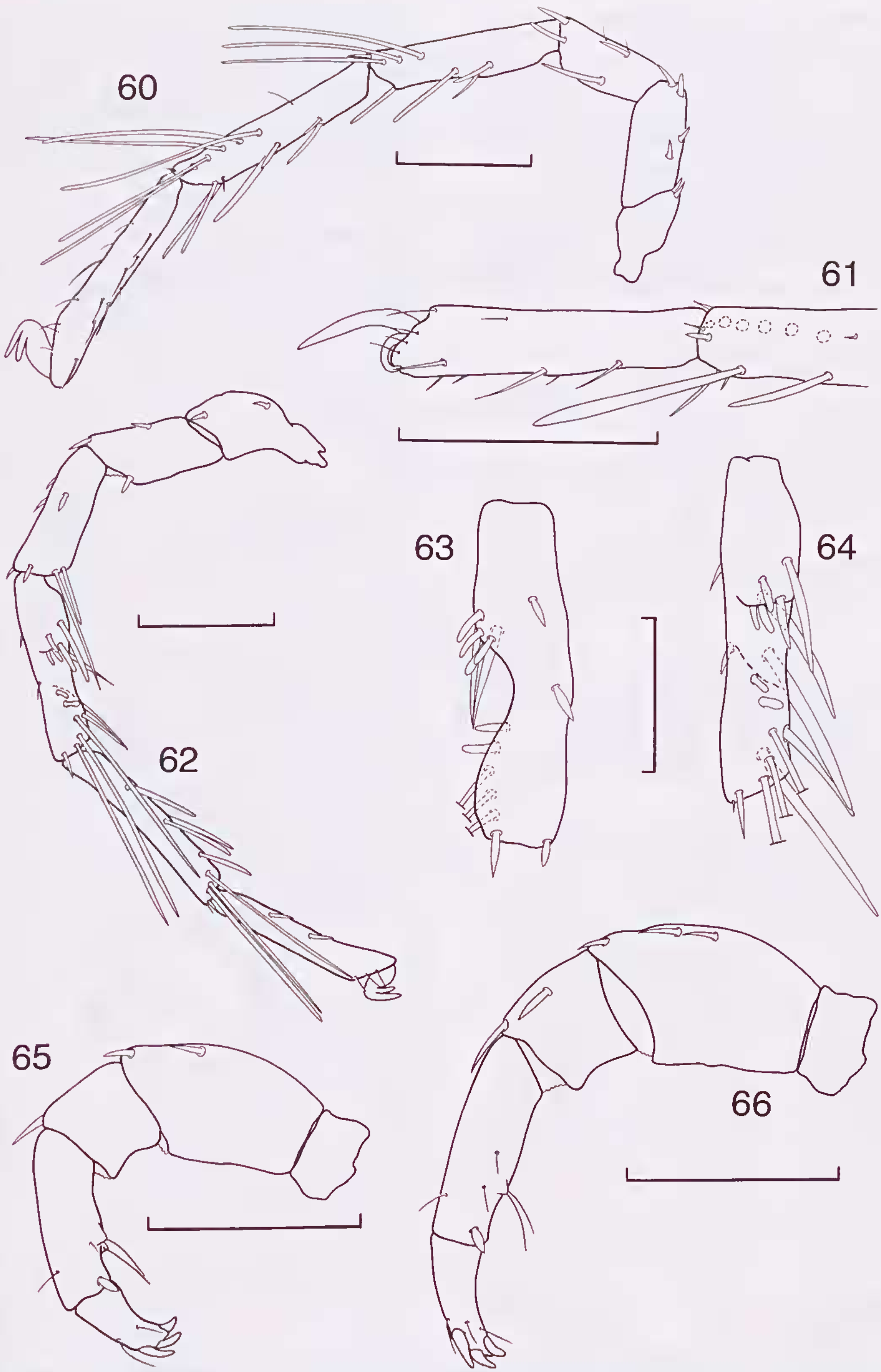
Description

Adult

Colour (in alcohol) pale yellow. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia (Figures 55, 58, 59). Dorsum (Figure 58): with a single pair of dorsalia. Venter (Figures 55, 59): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV extending antero-laterally. Genital region (Figures 56, 57): 5–6 (♂), 5–8 (♀) pairs of acetabula; those of ♂ all lying on acetabular plate, acetabula unequal in size, the posterior pair larger than remaining pairs; those of ♀ lying on small, scattered plates. Chelicera not examined. Pedipalp (Figures 65, 66): tibia with stout disto-ventral seta; tarsus with 3 disto-dorsal setae. Legs (Figures 60–64): ♂ tarsus III with extremely shortened and thickened tarsus, and with unequal claws, anterior claw shortest, without ventral clawlet (Figure 61); ♂ tibia IV with lateral concavity bearing 4 anterior and 2 posterior



Figures 55–59 *Piona australica* K.O. Viets: 55, ventral aspect, ♂; 56, genital field, ♂; 57, genital field, ♀; 58, dorsal aspect, ♀; 59, ventral aspect, ♀. Scale lines = 100 µm.



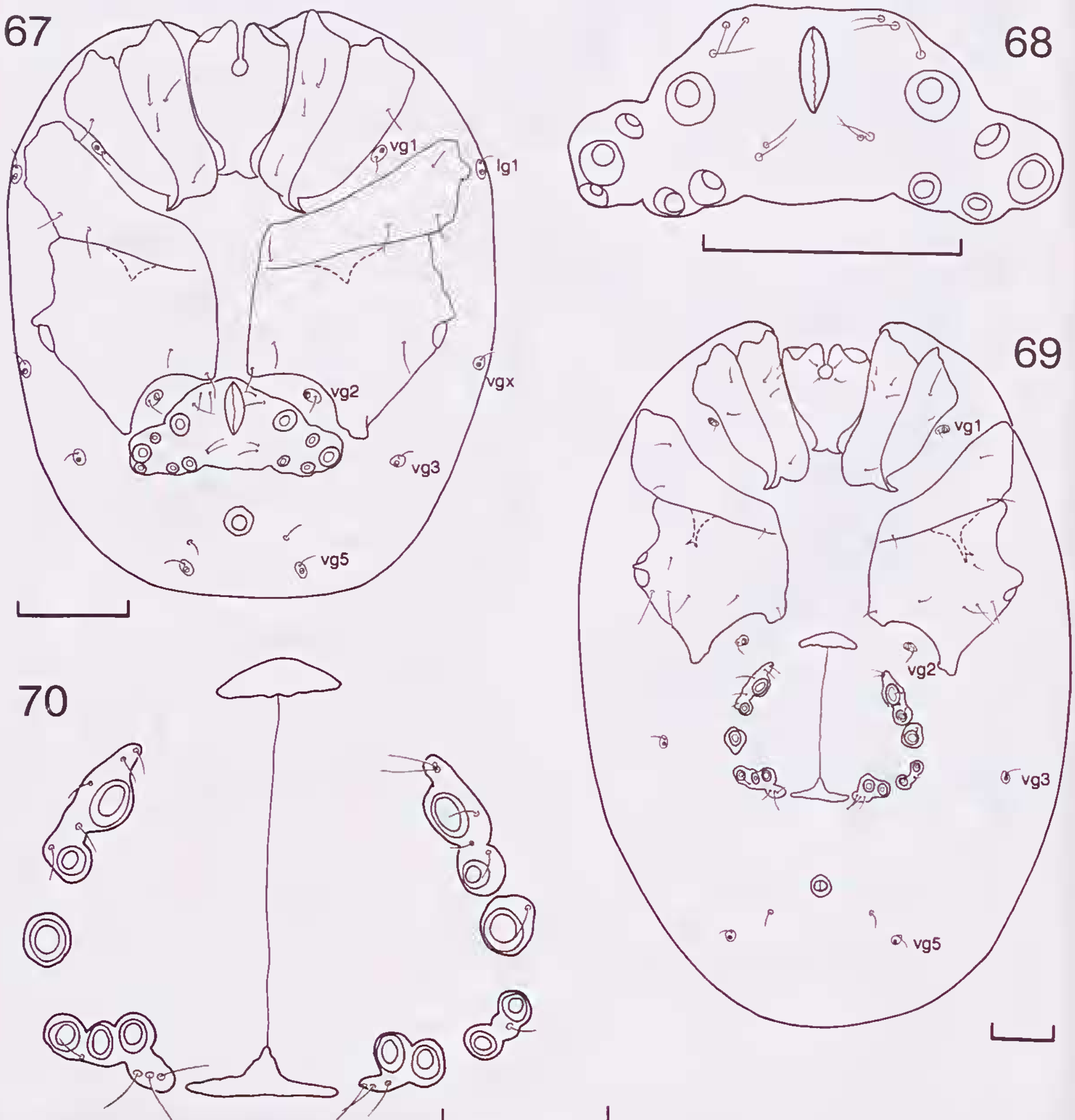
Figures 60–66 *Piona australica* K.O. Viets: 60, left leg I, ♂; 61, right leg III, detail of tarsus and distal portion of metatarsus, ♂; 62, left leg IV, ♂; 63, right tibia IV, dorsal, ♂; 64, left tibia IV, lateral, ♂; 65, left pedipalp, ♂; 66, right pedipalp, ♀. Scale lines = 100 μm.

peg-like setae (Figures 63, 64); legs with swimming setae arranged as follows: leg I: ♂, tibia 3, metatarsus 5; ♀, patella 0–2, tibia 6–8, metatarsus 12–14; leg II: ♂, tibia 3, metatarsus 6; ♀, patella 3–6, tibia 10–11, metatarsus 12–14; leg III: ♂, patella 2, tibia 6, metatarsus 5; ♀, patella 5–6, tibia 10–11, metatarsus 12–14; leg IV: ♂, tibia 3, metatarsus 3; ♀, patella 1–2, metatarsus 7–9, tarsus 3–4.

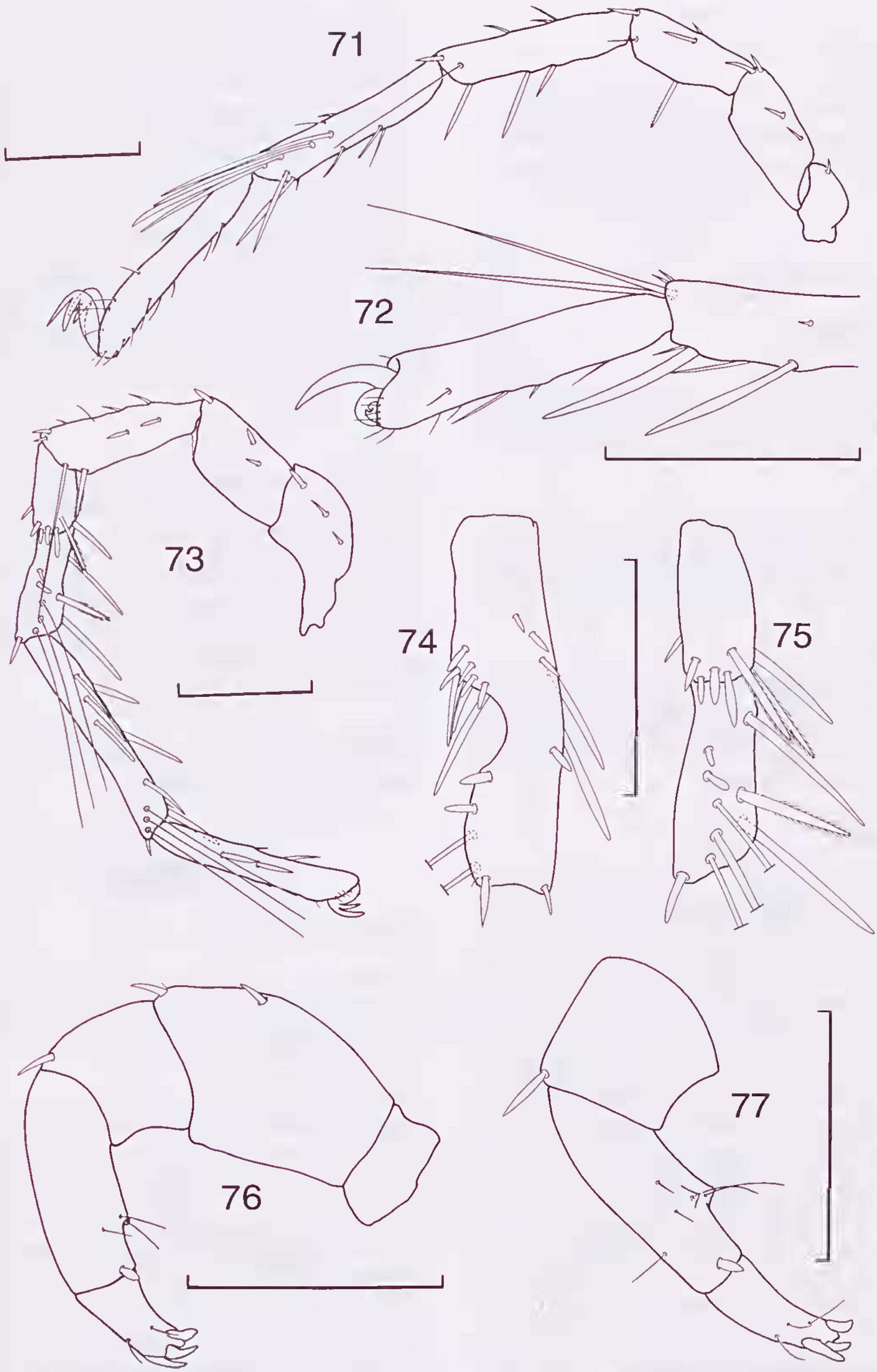
Dimensions (μm), ♂ (♀): body 512/384 (1193–1431/684–859); capitulum length 136 (167–206); genital field 84/175 (237–262/314–403). Pedipalp: trochanter 25 (29–35), femur 99 (103–127), patella 52 (54–63), tibia 88 (92–110), tarsus 52 (65–76). Leg I: trochanter 62 (90–96), femur 83 (115–134), patella 102 (140–154), tibia 147 (192–231), metatarsus 168 (210–268), tarsus 180 (213–273). Leg III: metatarsus 166, tarsus 127. Leg IV: trochanter 110 (122–160), femur 80 (94–132), patella 103 (137–192), tibia 146 (180–259), metatarsus 152 (197–282), tarsus 142 (204–253).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.



Figures 67–70 *Piona marchanti* sp. nov.: 67–68, holotype ♂: 67, ventral aspect; 68, genital field; 69–70, ♀ paratype: 69, ventral aspect; 70, genital field. Scale lines = 100 μm.



Figures 71–77 *Piona marchanti* sp. nov.: 71, left leg I, holotype ♂; 72, right leg III, detail of tarsus and distal portion of metatarsus, holotype ♂; 73, left leg IV, paratype ♂; 74, right tibia IV, dorsal, paratype ♂; 75, left tibia IV, lateral, paratype ♂; 76, right pedipalp, holotype ♂; 77, right pedipalp (patella, tibia, tarsus), paratype ♀. Scale lines = 100 μm.

Dimensions (µm): body 566/465.

Remarks

Piona australica belongs to the *variabilis* species-group as defined by Smith (1976). It appears to be widely distributed (Figure 52). See under the following species for characters by which *P. australica* and *P. marchanti* may be distinguished.

Piona marchanti sp. nov.

Figures 52, 67–77

Material Examined

Holotype

♂, Coonjimba Billabong, Jabiru Mining Camp, Northern Territory, Australia, 12°42'S, 132°54'E, 15 January 1980, R. Marchant (NMV K874; SL).

Paratypes

Australia: Northern Territory: 2♂, same data as holotype (NMV K875–876, SL, FL); 1♀, Mudginberri Billabong, Jabiru Mining Camp, 12°42'S, 132°54'E, 14 February 1980, R. Marchant (NMV K877; SL).

Diagnosis

Male genital field without deep, central pit; female genital field with acetabula lying on small, scattered plates. Pedipalpal tibia with stout, distal seta. Anterior claw of male tarsus III strongly curved, with ventral clawlet.

Description

Adult

Colour (in alcohol) pale yellow. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia (Figures 67, 69). Dorsum with a single pair of dorsalia. Venter (Figure 67, 69): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV extending antero-laterally. Genital region (Figures 68, 70): 5–8 (♂), 6–7 (♀) pairs of acetabula; those of ♂ all lying on acetabular plate, acetabula unequal in size, the posterior pair larger than remaining pairs; those of ♀ lying on small, scattered plates. Chelicera not examined. Pedipalp (Figures 76, 77): tibia with 2 large disto-ventral setiferous tubercles, and with disto-dorsal seta; tarsus with 3 disto-dorsal setae. Legs (Figures 71–75): ♂ tarsus III with unequal claws, anterior claw strongly curved, with curved ventral clawlet, posterior claw long and slightly curved (Figure 72); ♂ tibia IV modified, with posterior concavity lined with several proximal and 2 distal peg-like setae (Figures 74–75); legs with swimming setae arranged as follows: leg I: ♂, tibia 1–3, metatarsus 4–5; ♀, tibia 6, metatarsus 9; leg II: ♂, tibia 2–6, metatarsus 5; ♀, patella 2, tibia 9, metatarsus 13; leg III: ♂, patella 0–2, tibia 5–6, metatarsus 5; ♀, patella 1, tibia 10, metatarsus 12; leg IV: ♂, patella 2, tibia 3, metatarsus 3; ♀, patella 1, metatarsus 7, tarsus 4.

Dimensions (µm), ♂ (♀): body 557–614/403–429 (896/704); capitulum length 144–149 (179); genital field 80–90/194–214 (259/301). Pedipalp: trochanter 21–29 (?), femur 105–114 (?), patella 56–59 (59), tibia 89–97 (102), tarsus 48–52 (60). Leg I: trochanter 61–70 (83), femur 86–104 (115), patella 100–115 (132), tibia 151–170 (182), metatarsus 166–192 (213), tarsus 179–198 (220). Leg III: metatarsus 172–186, tarsus 125–128. Leg IV: trochanter 113–132 (128), femur 80–90 (108), patella 109–125 (161), tibia 145–159 (200), metatarsus 162–180 (221), tarsus 148–159 (204).

Remarks

Piona marchanti belongs to the *variabilis* species-group (Smith 1976), and is most similar to *P. australica*. It differs by possessing a small, curved ventral clawlet on the posterior claw of leg III (Figure 72) which is lacking in *P. australica*. Females of these two species are apparently indistinguishable. *Piona marchanti* has only been collected from two billabongs in what is now Kakadu Natl Park (Figure 52).

Etymology

This species is named for Richard Marchant, collector of the type specimens.

Piona murleyi sp. nov.

Figures 52, 78–89

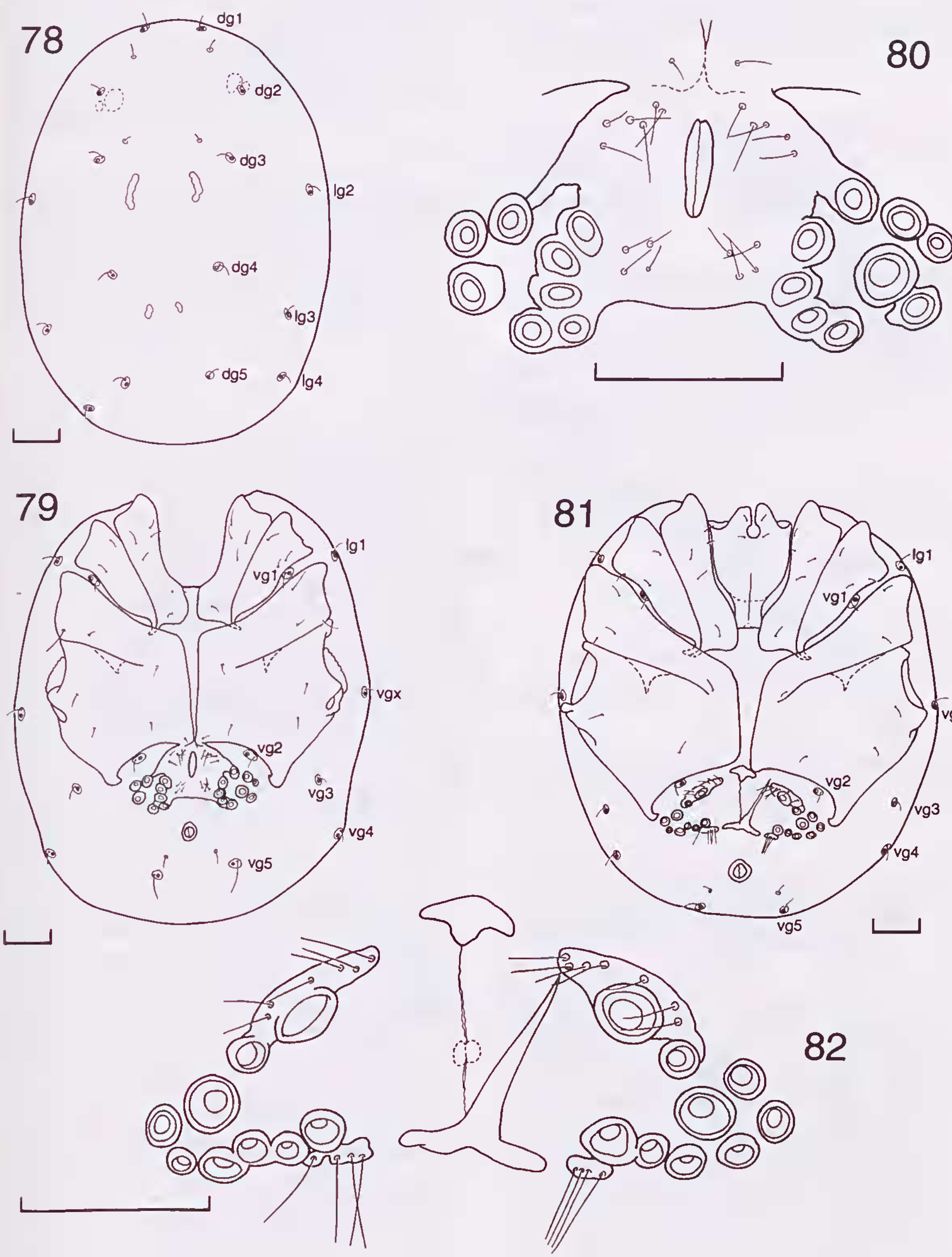
Material Examined

Holotype

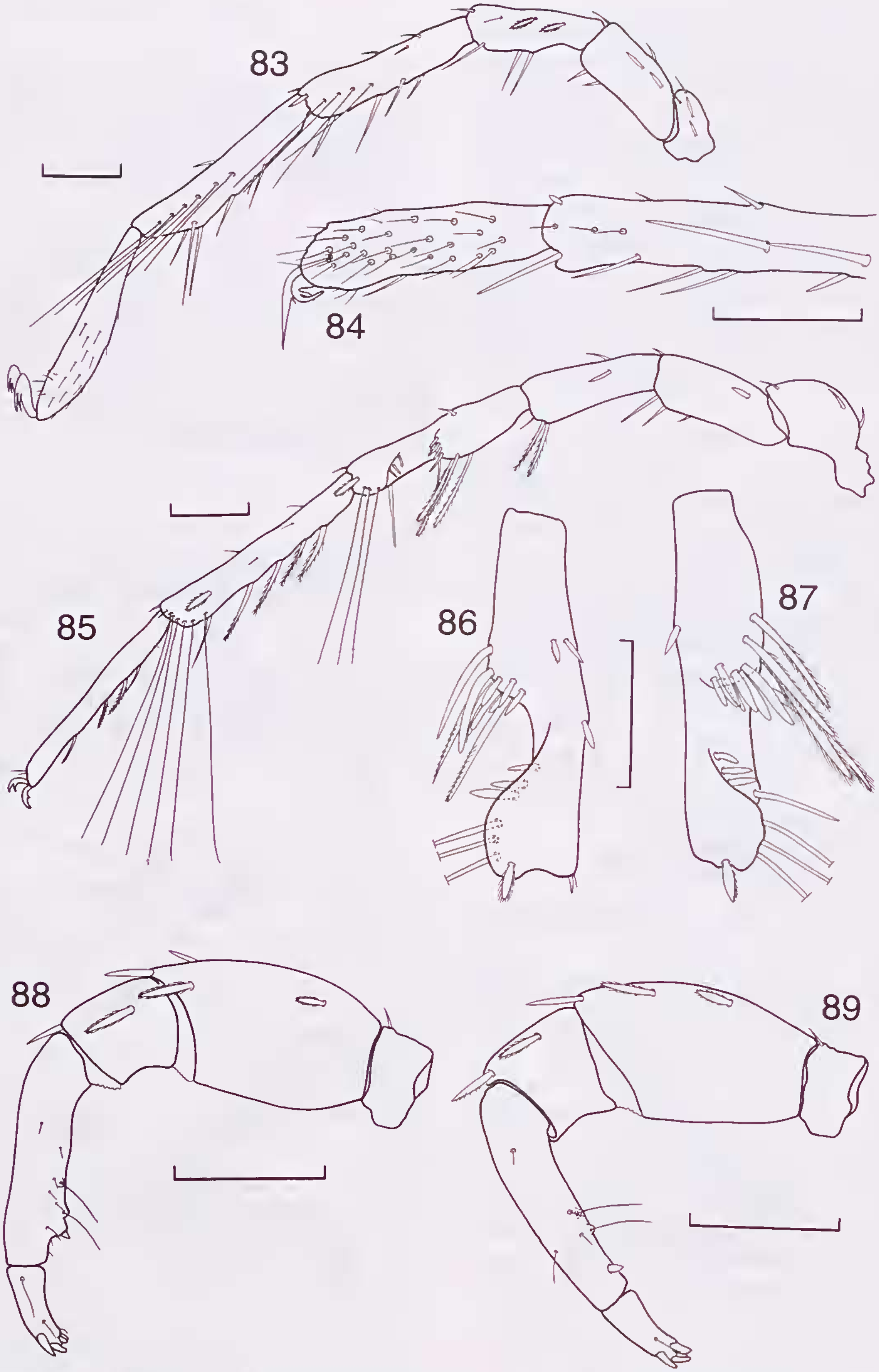
♂, swamp in Melaleuca Park, Western Australia, Australia, 31°42'S, 115°57'E, 25 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/2949; SL).

Paratypes

Australia: Western Australia: 14♂, 9♀, same data as holotype (WAM 88/2950–2955, 2958–2974; SL, FL); 10♂, 7♀, same data as holotype (NMV K881–882, 892, 878–880, 984–994; SL, FL); 2♂, 2♀, same data as holotype (SAM; FL); 2♂, 2♀, same data as holotype (ANIC; FL); 1♂, 1♀, same data as holotype (CNC; FL); 1♂, 1♀, same data as holotype (DCC; FL); 3♂, 5♀, Lake Pleasant View, 4 km NE. of Manypeaks, 34°50'S, 118°11'E, 2 September 1987, M.S. Harvey, J.D. Blyth (WAM 88/2975–2982; FL); 2♂, 5♀, same data (NMV K883–884, 886–890; FL); 2♂, small dam S. of Lake Poorginup, 34°33'S, 116°44'E, 31 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/2956–2957; SL); 1♂, Loch McNess,



Figures 78–82 *Piona murleyi* sp. nov.: 78–80, holotype ♂: 78, dorsal aspect; 79, ventral aspect; 80, genital field; 81–82, paratype ♂: 81, ventral aspect; 82, genital field. Scale lines = 100 μm.



Figures 83–89 *Piona murleyi* sp. nov.: 83, left leg I, holotype ♂; 84, right leg III, detail of tarsus and distal portion of metatarsus, holotype ♂; 85, left leg IV, holotype ♂; 86, right tibia IV, paratype ♂; 87, left tibia IV, holotype ♂; 88, left pedipalp, paratype ♂; 89, right pedipalp, paratype ♀. Scale lines = 100 μm.

Yanchep Natl Park, 31°32'S, 115°40'E, 25 August 1987, M.S. Harvey, J.D. Blyth (WAM 88/2983; FL); 3♂, North Sister Lake, 5 km N. of Manypeaks, 34°48'S, 118°09'E, 2 September 1987, M.S. Harvey, J.D. Blyth (NMV K893–895; FL); 2♂, 4 deutonymphs, Thompson Lake [32°09'S, 155°50'E], 30 August 1985, M.S. Harvey, T.J. Doeg, B. Murley (NMV K999–1004; SL).

Diagnosis

Male genital field without deep, central pit; female genital field with acetabula lying on small, scattered plates. Male pedipalpal tibia with stout, sub-distal seta, set in tubercle; that of female distal, not set in tubercle. Anterior claw of male tarsus III strongly curved, with ventral clawlet.

Description

Adult

Colour pale yellow, legs pale maroon. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia (Figures 78–79, 81). Dorsum (Figure 78): with 2 pairs of dorsalia, anterior pair larger than posterior pair. Venter (Figures 79, 81): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV extending antero-laterally, not reaching mid-line. Genital region (Figures 80, 82): 6–13 (usually 9–10) (♂), 9–14 (usually 9–10) (♀) pairs of acetabula; those of ♂ mostly situated on plate which is attached to coxae; those of ♀ lying on small, scattered plates. Chelicera not unusual. Pedipalp (Figures 88–89): tibia of ♂ with stout ventral seta sub-distal, set in tubercle, of ♀ distal; tarsus with 4 disto-dorsal setae. Legs (Figures 83–87): ♂ tarsus III setose, with slightly shortened and thickened tarsus; claws unequal, anterior claw strongly curved, with ventral clawlet, posterior claw long and nearly straight, with ventral clawlet (Figure 84); ♂ tibia IV modified, with posterior concavity lined with several proximal and 3 (rarely 2) distal peg-like setae (Figures 86–87); legs II, III and IV with swimming setae arranged as follows: leg I: ♂, tibia 3–4, metatarsus 5–6; ♀, tibia 5–8, metatarsus 8–10; leg II: ♂, tibia 4–7, metatarsus 6–7; ♀, tibia 8–10, metatarsus 8–12; leg III: ♂, tibia 5–9; ♀, tibia 10–11, metatarsus 9–12; leg IV: ♂, metatarsus 5–6; ♀, tibia 6–8, metatarsus 6–9.

Dimensions (µm), ♂ (♀): body 659–864/531–704 (859–992/747–827); capitulum length 181–219 (262–276); chelicera length 255–291 (309–331); genital field 116–152/267–304 (138–160/320–351). Pedipalp: trochanter 35–45 (38–51), femur 148–167 (164–182), patella 73–87 (82–96), tibia 143–172 (168–197), tarsus 52–68 (68–77). Leg I: trochanter 77–93 (83–114), femur 93–128 (122–150), patella 134–179 (160–198), tibia 178–237 (230–291), metatarsus 209–280 (256–330), tarsus 197–278 (254–313). Leg III: metatarsus 232–307, tarsus 127–172. Leg IV: trochanter 139–187 (171–206), femur 109–147 (147–179), patella 154–179 (223–262), tibia 218–250 (293–374), metatarsus 246–314 (312–403), tarsus 211–282 (244–339).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Dimensions (µm): body 614/467.

Remarks

Piona murleyi belongs to the *variabilis* species-group as defined by Smith (1976), and differs from the other species of the group by the position and morphology of the seta on the male pedipalpal tibia. *Piona murleyi* is apparently restricted to southwestern Australia (Figure 52), where it is common in lakes and swamps.

Etymology

This species is named for Brendon Murley, who assisted in the collection of this species at one site.

Piona puripalpis K.O. Viets
Figures 52, 90–100

Piona puripalpis K.O. Viets, 1984: 429, figs 41–45.

Types (not examined)

Holotype

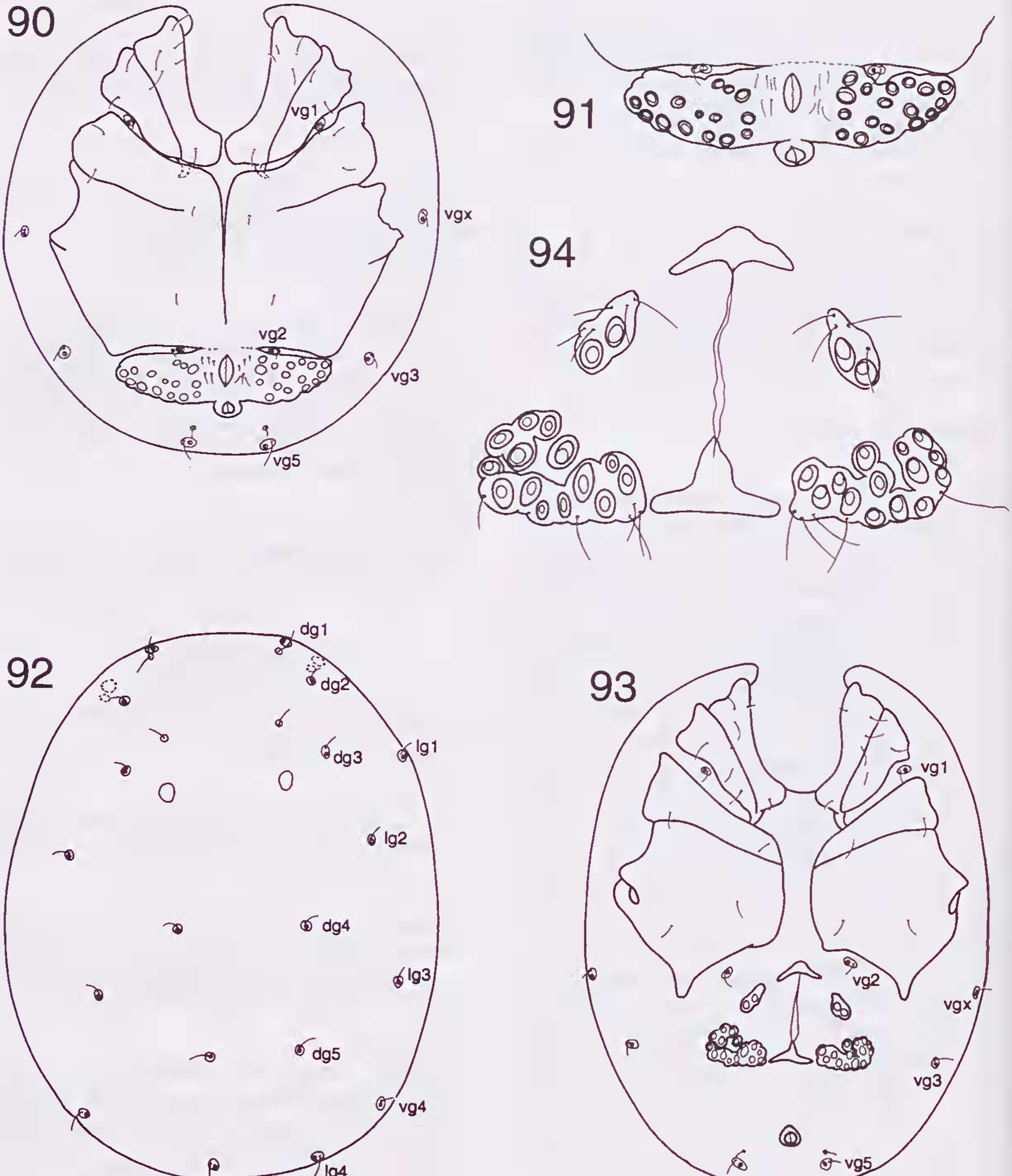
♂, Station Spring, via Mataranka, Roper Valley, Northern Territory, Australia [*ca.* 14°55'S, 133°04'E], 12 July 1981, B.V. Timms (VC).

Paratype

Australia: **New South Wales:** 1♀, mining pool no. 11, Crowdy Head via Taree [31°51'S, 152°45'E], 6 September 1980, B.V. Timms (VC).

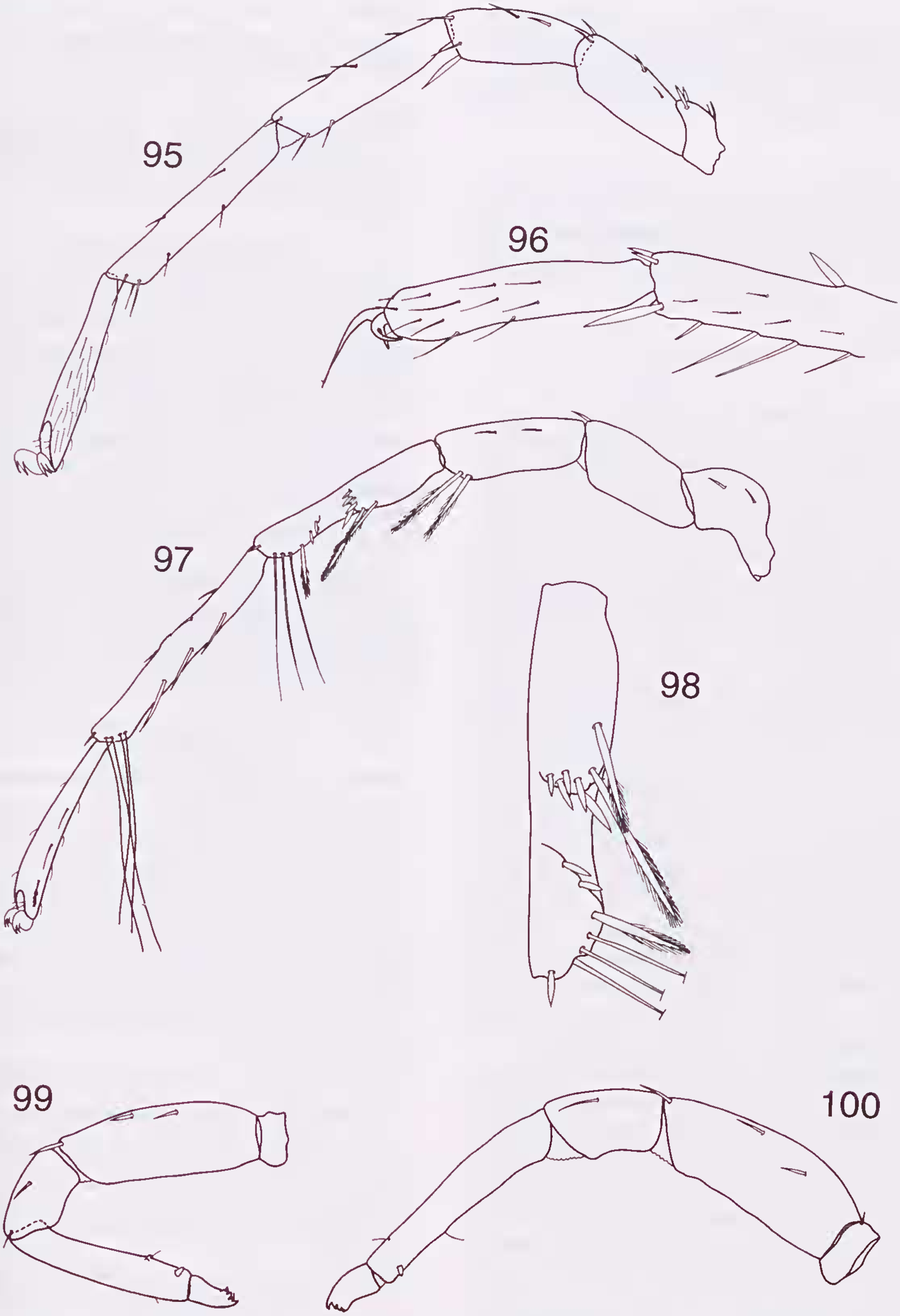
Material Examined

Australia: **Northern Territory:** 1♀, Coonjimba Billabong, Jabiru Mining Camp, 12°42'S, 132°54'E, 12 June 1979, R. Marchant (NMV; FL); 1♀, same data except 7 August 1979 (NMV; FL); 1♂, same data except 4 September 1979 (NMV; FL); 1♀, Dunlop's Swamp, Katherine Gorge Natl Park [*ca.* 12°19'S, 132°30'E], 7 July 1987, M.S. Harvey, A.L. Yen (NMV; FL); 1♂, 1♀, billabong on Flying Fox Creek, Kakadu Natl Park [*ca.* 12°44'S, 132°22'E], 30 June 1987, M.S. Harvey, A.L. Yen (NMV; FL); 7♂, 6♀, Fogg Dam [12°34'S, 131°17'E], 29 June 1987, M.S. Harvey, A.L. Yen (NMV; SL, FL); 16♂, 4♀, same data except 13 July 1987 (NMV; FL); 2♀, Georgetown Billabong, Jabiru Mining Camp, 12°42'S, 132°54'E, 30 April 1979, R. Marchant



Figures 90–94 *Piona puripalpis* K.O. Viets: 90–91, ♂: 90, ventral aspect; 91, genital field; 92–94, ♀: 92, dorsal aspect; 93, ventral aspect; 94, genital field. Scale lines = 100 μm.

(NMV; FL); 1♀, same data (NMV; FL); 1♂, 1 deutonymph, Goanna Billabong, Jabiru Mining Camp, 12°42'S, 132°54'E, 5 April 1979, R. Marchant (NMV; FL); 3♂, 3♀, same data except 12 July 1979 (NMV; FL); 1♂, same data except 16 January 1980 (NMV; FL); 1♂, Jabiluka Billabong, Kakadu Natl Park [12°28'S, 132°52'E], 3 July 1987, M.S. Harvey, A.L. Yen (NMV; FL); 2♂, 8♀, larvae, Kapalga Billabong, Kakadu Natl Park [12°36'S, 132°26'E], 2 July 1987, M.S. Harvey, A.L. Yen (NMV; FL); 1♀, Malabanbandju Billabong [12°46'S, 132°45'E], 3 July 1987, M.S. Harvey, A.L. Yen (NMV; FL); 4♂, 3♀,



Figures 95–100 *Piona puripalpis* K.O. Viets: 95–99, ♂: 95, left leg I; 96, right leg III, detail of tarsus and distal portion of metatarsus; 97, left leg IV; 98, left tibia IV, lateral; 99, right pedipalp; 100, right pedipalp, ♀. Scale lines = 100 µm.

Mudginberri Billabong, Jabiru Mining Camp, 12°42'S, 132°54'E, 13 July 1979, R. Marchant (NMV; FL). **Western Australia:** 4♂, 3♀, billabong on Arthur Ck, 135 km N. of Turkey Creek [16°03'S, 128°21'E], 11 July 1987, M.S. Harvey, A.L. Yen (WAM 88/3019–3025; FL).

Diagnosis

Male genital field without deep, central pit; female genital field with acetabula lying on small, scattered plates. Pedipalpal tibia with small, sub-distal seta. Anterior claw of male tarsus III strongly curved, with ventral clawlet.

Description

Adult

Colour pale blue-green. Glandularia: 5 pairs of dorsoglandularia, 4 pairs of lateroglandularia, and 6 pairs of ventroglandularia present (Figures 90, 92–93). Dorsum (Figure 92): with 1 pair of dorsalia. Venter (Figures 90, 93): apodemes of coxa I very short; suture lines between coxae I and II and coxae III and IV present; suture lines between coxae III and IV extending laterally (♂) or antero-laterally (♀). Genital region (Figures 91, 94): with 14–23 (♂), 11–16 (♀) pairs of acetabula; ♂ genital field fused to posterior margin of coxae IV. Chelicera stout. Pedipalp (Figures 99–100): segments, especially femur and tibia, elongate; tibia with stout, blunt, ventral, sub-distal seta; tibia with 1 indistinct disto-ventral setiferous tubercle, tubercle often absent in ♀; tarsus with 4 disto-dorsal setae. Legs (Figures 95–98): ♂ tarsus III with slightly shortened and thickened tarsus, and with unequal claws, posterior claw long and slender, anterior claw strongly curved with ventral clawlets (Figure 96); ♂ tibia and metatarsus IV modified, with posterior concavity lined with several proximal and 2 distal peg-like setae (Figure 98); legs II, III and IV with swimming setae arranged as follows: leg II: ♂, tibia 0–2, metatarsus 3–4; ♀, tibia 1, metatarsus 4–5; leg III: ♂, patella 0–1, tibia 3–5, metatarsus 5–6; ♀, patella 0–1, tibia 5, metatarsus 6–7; leg IV: ♂, tibia 3, metatarsus 5; ♀, tibia 3–4, metatarsus 5–7.

Dimensions (µm), ♂ (♀): body 531–704/442–499 (819–922/589–608); capitulum length 164–186 (203–212); chelicera length 198 (193); genital field 70–84/249–287 (160–174/256–275). Pedipalp: trochanter 25–27 (29–30), femur 173–198 (202–221), patella 86–103 (107–121), tibia 166–195 (204–218), tarsus 44–52 (54–58). Leg I: trochanter 64–68 (79–86), femur 102–109 (120–128), patella 133–150 (141–167), tibia 175–205 (202–224), metatarsus 211–230 (231–244), tarsus 188–211 (204–216). Leg III: metatarsus 199–225, tarsus 122–126. Leg IV: trochanter 128–134 (148–163), femur 97–103 (122–134), patella 134–145 (179–192), tibia 173–192 (243–251), metatarsus 220–246 (257–289), tarsus 176–191 (186–218).

Deutonymph

Much as in adults except that vgx is absent; genital region with 2 pairs of acetabula.

Remarks

Piona puripalpis belongs to the *rotunda* species-group as defined by Smith (1976). It is known from northern and eastern Australia (Figure 52).

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